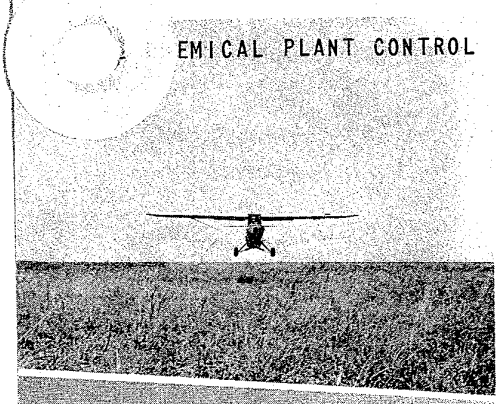
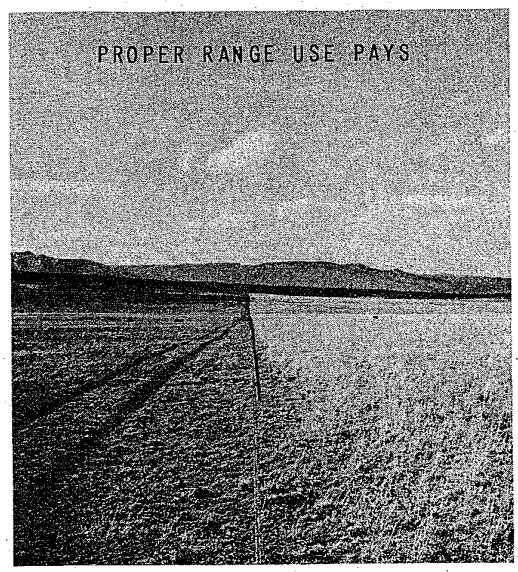
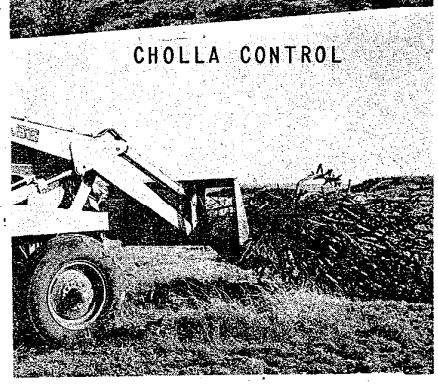
RANGE CONSERVATION - TECHNICAL NOTES







U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW MEXICO

RANGE TECHNICAL NOTE NO. 60

May 24, 1973

Re: Seeding Non-irrigated Lands in New Mexico

This Range Technical Note transmits Report No. 10 of the New Mexico Interagency Range Committee.

This report can be used as reference for planning and application of range and dryland pasture seedings.

Additional copies are available from the state office. Submit requests to the Plant Sciences Section.

Attachment

AO
WRTSC, Portland - 2
Adjoining States - 1

Report No. 10 February 1973

SEEDING
NON-IRRIGATED LANDS
IN
NEW MEXICO

New Mexico Inter-Agency
Range Committee
Co-Chairmen
Daniel L. Merkel
Soil Conservation Service
Carlton H. Herbel
Agricultural Research Service

Request copies from:
Agricultural Research Service
U.S. Department of Agriculture
P. O. Box 698
Las Cruces, New Mexico 88003

Seeding Non-Irrigated Lands in New Mexico

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SEEDING NON-IRRIGATED LANDS IN NEW MEXICO

New Mexico Inter-Agency Range Committee
Report No. 10

Daniel L. Merkel and Carlton H. Herbel
Soil Conservation Service
Agricultural Research Service

Preface

This paper presents the results of field evaluations of range seeding on May 22-26 and October 2-6, 1972, by the New Mexico Inter-Agency Range Committee. The study included non-irrigated seedings completed on private, Indian and federal lands during a period of over 35 years. Also included are the best recommendations from a number of individuals on seeding New Mexico rangelands.

The spring meeting was conducted in the Mountainair, Clovis, Tucumcari and Clayton areas. Alamogordo, Carrizozo and Mescalero were the locations of the fall meeting.

It is felt all parties recommending or making range seeding within New Mexico would benefit from these evaluations and report.

The following is a list of the people who attended all or part of these New Mexico Inter-Agency Range Committee meetings and the committee members who were not able to attend:

Agricultural Research Service	
Wesley Keller, Investigations Leader	Logan, Utah
*Carlton H. Herbel, Range Scientist	Las Cruces, N.M.
Phil Luginbill, Assistant Area Director	Tucson, Arizona
Agricultural Stabilization and Conservation Service	
**Ray Wolf	Albuquerque, N.M.
Bureau of Indian Affairs	
*George W. Knoll, Range Conservationist	Albuquerque, N.M.
**Wilson Gutzman, Area Range Conservationist	Albuquerque, N.M.
Sampson Miller	Mescalero, N.M.
Ed Gomer	Mescalero, N.M.
Bureau of Land Management	
*Bill Leifeste, Range Conservationist, Watershed	Santa Fe, N.M.
**Mervin Noble, Leader, Soil and Water Staff	Denver, Colo.
Harlan Smith	Santa Fe, N.M.
Duane Michael	Albuquerque, N.M.

Grass Seed Growers and Dealers	
Art Armbrust - Sharp Bros. Seed Co.	Healy, Kansas
J. V. Curtis - Curtis and Curtis Seed Co.	Melrose, N.M.
Gail E. Sharp - Sharp Bros. Seed Co.	Healy, Kansas
New Mexico Crop Improvement Association	
T. C. Perkins, Administrative Officer	Las Cruces, N.M.
New Mexico Cattle Growers	
Jasper Koontz, Rancher	Vaughn, N.M.
New Mexico Game and Fish Department	
*Samuel H. Lamb	Santa Fe, N.M.
Art Crownover	Los Lunas, N.M.
New Mexico Property Appraisal Department	
**Scott Stevenson, Agricultural Economist	Santa Fe, N.M.
New Mexico State Land Office	
Marlin Hanson	Santa Fe, N.M.
**Dwain Glidewell	Santa Fe, N.M.
New Mexico State University - Agricultural Services	
**Jesse Gerard, Asst. Professor	Las Cruces, N.M.
New Mexico State University - Agronomy Department	
*Walter Gould, Associate Professor	Las Cruces, N.M.
New Mexico State University - Extension Service	
Billy C. Smith	Portales, N.M.
*Robert Steger, Extension Range Specialist	Las Cruces, N.M.
F. Zimmerman	Clayton, N.M.
Soil Conservation Service - Retired	
E. Hemphill	Clayton, N.M.
Jay Dickens	Clayton, N.M.
New Mexico State University - Range Department	
*Rex D. Pieper, Associate Professor, Range Science	Las Cruces, N.M.
Reldon Beck, Asst. Professor, Range Science	Las Cruces, N.M.
Gary Donart, Associate Professor, Range Science	Las Cruces, N.M.
New Mexico State University - Plant Materials Center	
James Anderson, Manager	Los Lunas, N.M.
Ranchers	
C. H. Fulfer	Mountainair, N.M.
Vernie Wills	Mountainair, N.M.
Art Jenkins	Clayton, N.M.

Soil Conservation Service

*Daniel L. Merkel, Plant Materials Specialist	Santa Fe, N.M.
*Don Sylvester, Range Conservationist	Albuquerque, N.M.
Richard Barber, District Conservationist	Bernalillo, N.M.
Mike Somerville, Range Conservationist	Portales, N.M.
Larry Nunez, District Conservationist	Portales, N.M.
Robert Lohmiller, Soil Conservationist	Los Lunas, N.M.
Leaford Windle, Soil Conservationist	Los Lunas, N.M.
Noel Marsh, Range Conservationist	Roswell, N.M.
Jim Reeves, District Conservationist	Clovis, N.M.
Lonnie Schultz, District Conservationist	Clayton, N.M.
Don Alan, Range Conservationist	Artesia, N.M.

U. S. Forest Service

*Robert M. Williamson, Range Staff	Albuquerque, N.M.
Ron Haag, District Ranger	Clayton, N.M.
Don Bilbrey, District Ranger	Texline, Texas
G. Henkey	Texline, Texas
*W. F. Currier, Range Staff	Albuquerque, N.M.
**Wayne Hickey, Range Staff	Albuquerque, N.M.
*John Chambers, Range Staff	Albuquerque, N.M.
Bill Ashcroft	Cloudcraft, N.M.
Paul Gordon, Range Staff Officer	Alamogordo, N.M.

U. S. Forest Service - Rocky Mountain Forest and Range Experiment Station

*H. Wayne Springfield	Albuquerque, N.M.
**Oren D. Knipe	Albuquerque, N.M.

*Committee members participating
**Committee members not participating

I. Introduction

Range seeding has been a concern of most people involved in rangeland and related resource management. The subject has received considerable attention in most meetings of the New Mexico Inter-Agency Range Committee since it started in 1967. The following reports of the Committee include information and recommendations on seeding in relation to the major topic:

No. 1 - September, 1967 - Improving Sagebrush Ranges in New Mexico

No. 2 - April, 1968 - Improving Pinyon - Juniper Ranges in New Mexico

No. 4 - November, 1970 - Control of Shinnery Oak, Mesquite, and Creosotebush in New Mexico

No. 7A- June, 1971 - Proceedings - Critical Area Stabilization Workshop

No. 7 - January, 1973 - Critical Area Stabilization in New Mexico

No. 8 - July, 1971 - Land Management Practices for the Reduction of Runoff and Erosion in New Mexico

No. 9 - August, 1971 - Game Range Improvement in New Mexico

Although these earlier reports discuss revegetation as it relates to special problems, this is a complete report of dryland seeding in New Mexico.

The main purpose of this paper is to provide guidance in establishing adapted plants on non-irrigated rangelands, to (1) provide soil stabilization; (2) alter vegetative composition to meet the user's objectives for forage; (3) manipulate vegetation; and (4) improve wildlife habitat.

The principles of seeding presented here will apply to all grass, legume and shrub plantings made for any purpose in New Mexico. The species and variety recommendations are sound for all but irrigated tame pasture and hayland plantings. Seeding recommendations for a given area should be made only after an on-site inspection by the concerned individuals.

II. Description of New Mexico

A. Basis of Land Resource Areas (Table No. 1):

For the purpose of making seeding recommendations, New Mexico is divided into land resource areas and sub resource areas in this report. This division, which is based on climate and soil conditions, recognizes the differences in vegetative potentials within the state. The Land Resource Area map (Table No. 1) does not show small acreages of one resource area which are included within the boundaries of other larger resource areas.

1. Climate -- The land resource areas and seeding discussions recognize three major temperature and precipitation patterns in the state. These are listed below with the land resource areas (or sub areas) that have the given climatic conditions:

   a. Cold moist winters - These areas are usually at high elevations with cold temperatures and over 50% winter moisture. Cool season species would dominate the climax vegetation. Big sagebrush is commonly the major species now. Resource areas included in this climatic zone are:

      (1) Southern Rocky Mountains (RM-1)

      (2) Arizona and New Mexico Mountains, northern part (RM-2)

      (3) New Mexico and Arizona Plateaus and Mesas - Sub areas 1 and northern 2 (WP-1 and WP-2)

      (4) San Juan River Valley Mesas and Plateaus (ND)

      (5) High Intermountain Valleys (HIV)

   b. Cold dry winters - These are cold areas with less than 50% of the annual precipitation occurring during the winter. They include:

      (1) Pecos - Canadian Plains and Valleys - Sub areas 1, 2 and 3 (CP-1, CP-2 and CP-3)

      (2) Southern High Plains - Sub areas 1, 2 and northern 3 (HP-1, HP-2 and HP-3)

(3) New Mexico and Arizona Plateaus and Mesas - Sub areas southern 2 and northern 3 (WP-2 and WP-3)

(4) Arizona and New Mexico Mountains, southern part (RM-2)

c. Warm dry winters - Winter moisture is less than summer moisture, and temperature means are above those at higher elevations. Resource areas included are:

(1) Southern Desertic Basins, Plains and Mountains (SD-1, SD-2, SD-3)

(2) Southern High Plains - Sub area southern 3 (HP-3)

(3) Pecos - Canadian Plains and Valleys - Sub area 4 (CP-4)

(4) New Mexico and Arizona Plateaus and Mesas - Sub area southern 3 (WP-3)

2. Soils - Next to climate, soils are the most important factor influencing range seeding techniques. New Mexico soils include a broad range of parent materials, textures, structures, vegetative limitations and erosion hazards. The Committee recognizes these differences, but for the purpose of this report the most extensive soils are combined into five soil groups. They are:

a. Sandy - This includes sands, sandy loams, and loamy sands. It also includes all loams with a calcarious layer within the top 16 inches and lime to the surface.

b. Loam - Loams, except those included in sandy, and clay loams not derived from shales and red bed materials are included in this group.

c. Clay - Clay loams, except those in the loam unit, and clays make up this group.

d. Salty - This group includes all soils which contain enough salts to limit species selection. Alkali sacaton usually makes up over 50% of the vegetation on these soils in climax condition.

e. Wet - All soils with an active water table (usually within 5 feet of the surface) compose this group.

Range seeding will normally be confined to the best and most productive soils on an operating unit. It is only on these sites that a favorable economic return can be expected. Therefore, steep, shallow and stony soils are not included in the above groups. In some cases, however, conditions will require treatment including seeding. In such cases the following considerations should be included in the planning.

a. Recommendations included in Committee Report No. 7, "Critical Area Stabilization in New Mexico", should be followed on steep, infertile soils and other critical sites.

b. Soils with more than 50% stone in the profile favor tap rooted species. Therefore, forbs and shrubs should be considered for seeding on these sites.

c. Species and variety selection may be guided from those in the most similar soil group.

B. Description of Land Resource Areas[1/]

The following description of the major land resource areas is adapted from New Mexico State University Agricultural Experiment Station Research Report 147, "Major Land Resource Areas in New Mexico", by H. J. Maker and H. E. Dregne.

1. Southern High Plains (HP)

Includes an area of approximately 7,550,000 acres in the extreme eastern part of New Mexico. Nearly level to gently sloping plains broken only by a few drainageways and playas. There are minor areas with steep slopes and dune-like topography. Elevations range from about 3,600 feet in the south to about 6,000 feet in Colfax County in the north. All this resource area except the southern ¼ is in the cold dry winter climatic zone. The extreme southern part is in the warm dry winter area.

1/ For additional information about Land Resource Areas, see USDA Handbook 296.

a. Climate -

Annual rainfall: 15 to 18 inches
Annual temperature: 52 to 61° F.
Growing season: 160 to 206 days

b. Soils -

(1) Deep, neutral, dark-brown to reddish-brown loamy fine sands, fine sandy loams, and loams. Major soil series: Amarillo, Pullman, Olton, Dalhart, Gruver, Brownfield, Tivoli, Stegall, Dioxice.

(2) Shallow to moderately deep, grayish-brown to dark grayish-brown, sandy loams and fine sandy loams. Underlain typically by soft or cemented lime. Major soil series: Kimbrough, Potter, Mansker, Lea, Portales.

c. Land Use - Dry cropland (winter wheat and sorghums): about 1,400,000 acres. Irrigated land (cotton, grain sorghum, small grains, vegetable crops, alfalfa, peanuts): about 430,000 acres. Range (blue grama and buffalograss on loam soils; bluestem, Indiangrass, and sideoats grama on sandy soils): about 5,720,000 acres. Estimated acreage of irrigable soils: 5,124,000 acres.

2. Pecos - Canadian Plains and Valleys (CP)

Includes an area of approximately 18,390,000 acres in eastern New Mexico, between the high plains and the mountains. Gently undulating to rolling uplands interspersed with relatively smooth valleys and basins. Few isolated mountains and mesas. Steeply sloping lands adjacent to the larger streams. Elevations over the major part of the area range from 4,000 to 7,000 feet. Those peaks above 7000 feet are in mountain resource areas. Sub resource areas 1, 2 and 3 are in the cold dry winter climatic zone. Sub area 4 is in the warm dry winter zone.

a. Climate -

Annual rainfall: 13 to 16 inches
Annual temperature: 49 to 58° F.
Growing season: 130 to 196 days

b. Soils -

(1) Shallow, light brown to grayish-brown loams and gravelly loams. Underlain by limestone, basalt, caliche, and sandstone. Major soil series: Pastura, Dean, Travessilla, Apache, Bernal, Ector, La Porte.

(2) Moderately deep and deep, light brown to dark grayish-brown loams and clay loams dominant. Loamy fine sands and sandy loams common in extreme eastern part of area. Major soil series: Witt, Clovis, Manzano, Colmor, Swastika, Quay, Montoya, Hagerman, Torreon, Tricon, Palma, Ima, Moriarty, La Fonda, Alicia.

c. Land Use - Range (blue grama, western wheatgrass, galleta on loamy soils; little bluestem, sideoats grama, sand dropseed on sandy soils; pinyon and juniper on mesa breaks and steeply sloping areas): about 18,293,000 acres. Irrigated land (small grains, alfalfa, sorghum corn, pastures): about 97,000 acres. Estimated acreage of irrigable soils: 5,114,000 acres.

3. Southern Desertic Basins, Plains and Mountains (SD)

Includes an area of approximately 21,000,000 acres in southern New Mexico. Broad basin floors, gently sloping plains, flood plains of the Rio Grande and Pecos River, and desert mountains. Elevations range from 3,000 to 5,000 feet in basins and valleys. Areas above 5000 feet are in other resource areas. Sub resource area 1 is in the cold dry winter climatic zone. Sub resource areas 2 and 3 are in the warm dry winter zone.

a. Climate -

Annual rainfall: 8 to 12 inches
Annual temperature: 56 to 63° F.
Growing season: 175 to 217 days

b. Soils -

(1) Moderately deep and deep, light reddish brown to brown, sandy loams and loams dominant. Clay loams in basin floors, playas, and alluvial valley bottoms. Major soil series: Mohave,

Berino, Stellar, Mimbres, Hap, Reagan, Reeves, Gila, Glendale, Vinton, Bluepoint, Madurez, Kermit.

(2) Very shallow and shallow, light brownish-gray to pale brown, loamy fine sands, sandy loams, and loams. Underlain by gypsum, caliche, igneous rocks, sands, and gravels. Major soil series: Cacique, Holloman, Upton, Simona, Jal, Nickel, Caliza, Lehmans, Dona Ana, Strauss.

c. Land Use - Irrigated land (cotton, alfalfa, sorghum, small corn, vegetables, pecans): about 470,000 acres. Range (black grama, blue grama, sand dropseed, burrograss, galleta, creosotebush, tarbush, mesquite on uplands; tobosa and alkali sacaton in swales and depressional areas): about 20,530,000 acres. Estimated acreage of irrigable soils: 8,389,000 acres.

4. High Intermountain Valleys (HIV)

Includes an area of approximately 830,000 acres in extreme north central New Mexico. Nearly level to gently rolling upland cut by steep canyon of the Rio Grande. A few isolated mountains. Elevations range from 7,000 to 8,000 feet on the plains. Peaks above 8,000 feet are in the Southern Rocky Mountain resource area. High Intermountain Valleys resource area is in the cold wet winter climatic zone.

a. Climate -

Annual rainfall: 10 to 15 inches
Annual temperature: 42 to 47° F.
Growing season: 111 to 142 days

b. Soils -

(1) Deep, reddish brown to brown, loams and clay loams dominant, with some gravelly loams and sandy loams. Major soil series: Hondo, Gabaldon, Fernando, Sheppard, and Torreon.

(2) Shallow, light brown to light brownish-gray loams and sandy loams. Underlain by basalt and gravels. Major soil series: Prieta and Cascajo.

c. Land Use - Irrigated land (small grains, corn, alfalfa, pastures, potatoes): about 42,000 acres. Range (blue grama, western wheatgrass, galleta, sand dropseed, snakeweed, big sagebrush on uplands; pinyon and juniper on breaks and mountains): about 738,000 acres. Estimated acreage of irrigable soils: 400,000 acres.

5. New Mexico and Arizona Plateaus and Mesas (WP)

Includes an area of approximately 14,390,000 acres in western New Mexico. Broad mesas and plateaus interspersed with deep canyons and dry washes. Some lava flows and volcanic cones. Elevations range from 5,000 to 7,500 feet, dominantly. Sub resource areas 1 and the northern part of 2 are in the cold wet winter climatic zone. The southern part of sub resource area 2 and northern part of 3 are in the cold dry winter zone. The southern 1/3 of sub resource area 3 is in the warm dry winter zone.

a. Climate -

Annual rainfall: 10 to 17 inches
Annual temperature: 46 to 54° F.
Growing season: 109 to 180 days

b. Soils -

(1) Moderately deep and deep, light brownish gray to brown, sandy loams and loams in uplands, loams, clay loams, and clays in bottomlands. Major soil series: Penistajo, Doak, Progresso, Sheppard, Las Lucas, Canoncito, Pedrick, Clovis, Navajo, Prewitt, Oscura, Billings, San Mateo, Poleo, Concho, Panky, Calabasas, Pojoaque.

(2) Very shallow and shallow, light brownish gray to brown, fine sandy loams, loams, and clay loams. Underlain by sandstone, shale, igneous rocks, and caliche. Major soil series: Persayo, Travessilla, Bernal, Prieta, Oro Grande, Luzena, and Harvey.

c. Land Use - Irrigated Land (small grains, alfalfa, corn, tree fruits): about 52,000 acres. Range (blue grama, sideoats grama, galleta, western wheatgrass, sand dropseed, big sagebrush, rabbitbrush, pinyon,

and juniper): about 14,338,000 acres. Estimated acreage of irrigable soils: 3,183,000 acres.

6. San Juan River Valley, Mesas, and Plateaus (ND)

Includes an area of approximately 2,860,000 acres. Moderately undulating to rolling plain, broken by small mesas, hogback ridges, bottomlands, and steeply sloping breaks adjacent to principal drainages. Elevations range from about 4,900 to 6,700 feet. This resource area is in the cold wet winter climatic zone.

a. Climate -

Annual rainfall: 7 to 10 inches
Annual temperature: 50 to 53° F.
Growing season: 140 to 170 days

b. Soils -

(1) Very shallow and shallow, light brownish gray to pale brown, sandy loams and silty clay loams. Underlain by shale, sandstone, and caliche. Major soil series: Persayo, Travessilla, Bad land, and Sandstone Rock land.

(2) Moderately deep and deep, light brownish gray, light reddish brown, and pale brown, loamy sands, sandy loams, loams, and clay loams. Major soil series: Blauding, Doak, Sheppard, Fruitland, Turley, Ravola, Billings, Navajo, and San Mateo.

c. Land Use - Irrigated land (alfalfa, corn, tree fruits, small grains, vegetables): about 50,000 acres. Range (galleta, blue grama, alkali sacaton, Indian ricegrass, sand dropseed, shadscale, big sagebrush, rabbitbrush, four-wing saltbush, and snakeweed): 2,810,000 acres. Estimated acreage of irrigable soils: 1,059,000 acres.

7. Southern Rocky Mountains (RM-1)

Includes an area of approximately 5,690,000 acres in northern New Mexico. Strongly sloping to precipitous mountains. Gently to moderately sloping

stream valleys and plateaus. Elevations range from 6,000 to 13,000 feet with 7,000 to 11,000 feet dominant. All this resource area is in the cold wet winter area.

a. Climate -

Annual rainfall: 16 to 30 inches
Annual temperature: 35 to 45° F.
Growing season: 35 to 110 days

b. Soils -

(1) Very shallow and shallow, brown to dark grayish brown loams, gravelly loams, and stony loams. Underlain by acid and basic igneous rocks, sandstone and shale. Major soil series: Raton, Midnight, Cabezon, Rock land.

(2) Moderately deep and deep, brown to very dark grayish brown loams, stony loams, silt loams, and clay loams. Major soil series: Barela, Bundo, Burnac, Dargol, Etown, Etoe, Mesita, Morval, Nambe, Penitente, and Rayado.

c. Land Use - Irrigated land (small grain, alfalfa, pasture): about 17,000 acres. Range (western wheatgrass, pine dropseed, Arizona fescue, mountain muhly, bluegrasses, blue grama, pinyon, juniper, mountain mahogany, and oak): about 2,573,000 acres. Timber (ponderosa pine, limber pine, Douglas fir, white fir, Engelmann spruce, and aspen): about 3,100,000 acres. Recreation (fishing, hunting, skiing). Estimated acreage of irrigable soils: 171,000 acres.

8. Arizona and New Mexico Mountains (RM-2)

Includes an area of approximately 7,057,000 acres. Strongly sloping to precipitous mountains. Gently to moderately sloping stream valleys and plateaus. Elevations range from 6,000 to 10,000 feet, dominantly; several mountain peaks over 11,000 feet. Three northern units of this resource area are in the cold wet winter climatic zone. The remainder is in the cold dry winter zone.

a. Climate -

Annual rainfall: 15 to 25 inches
Annual temperature: 40 to 52° F.
Growing season: 80 to 175 days

b. Soils -

(1) Very shallow and shallow, brown to dark grayish brown loams, gravelly loams and stony loams. Underlain by limestone, acid and basic igneous rocks, shale and sandstone. Major soil series: La Porte, Bandera, Cabezon, Kiln, Deama.

(2) Moderately deep and deep, brown to very dark grayish brown, sandy loams, loams and clay loams. Major soil series: Crest, Zuni, Tampico, Cloudcroft, Andrews, Wilcoxon, Fort Wingate, Jekley, Friana, McGaffey, Peso, Caballo, Mirabal, Remunda, Arosa.

c. Land Use - Irrigated land (tree fruits, vegetables, small grains, alfalfa, corn, pastures): about 11,000 acres. Range (western wheatgrass, pine dropseed, Arizona fescue, mountain muhly, bluegrasses, blue grama, sideoats grama, pinyon, juniper, mountain mahogany and oak): about 3,246,000 acres. Timber (ponderosa pine, limber pine, white fir, Douglas fir, Engelmann spruce, aspen): about 3,800,000 acres. Recreation (fishing, hunting, skiing). Estimated acreage of irrigable soils: about 70,000 acres.

III. Objectives of Seeding

Usually there are several objectives to seeding. They may include one or more of the following:

A. Soil Stabilization

Seeding is often necessary to reduce erosion by wind and water. Areas with little or no vegetation contribute greatly to pollution of air and water. These are often difficult sites to seed because they have unfavorable micro climates and infertile erosive soils. Areas bared by fire, construction and logging are included in this type of seeding.

Critical area stabilization techniques and associated mechanical land treatment are often necessary to seed for soil stabilization.

Species selection varies with soil stability, associated vegetation, future use and grazing pressure. A regular seeding mixture for the soil group may be used on stable soils where grazing can be carefully managed. On unstable soils and where grazing is difficult to regulate, species of the same or lower grazing preference than the associated vegetation should be considered.

In recommending mixtures for soil stabilization the following items should be considered:

1. Species must be included which will grow rapidly and give a cover in a minimum of time.

2. The species must be able to establish from broadcast seeding if it is impossible to drill.

3. Species should be included which have large, strong root systems to hold the soil in place.

B. Alter Vegetative Composition to Meet the User's Objectives

Plant control is done to replace existing vegetation with plants that better serve the management objectives.

Undesirable species have invaded millions of acres of New Mexico rangelands. In many woody plant areas there is an understory of desirable vegetation associated with the brush which will cover the area after the undesirable plants are controlled. However, range seeding is a necessary associated practice with brush control in many vegetative manipulation projects.

Recommendations on several methods of brush control to be used in conjunction with seeding are contained in earlier Committee reports.

Seeding following brush control may be necessary on the entire treated area, or small sites within the unit. Species selection, seeding methods and management may be different in these two conditions. These differences must be recognized and then included in the treatment plans.

Seeding to meet the user's objectives often means to improve and/or increase forage production. Seedings for this purpose are of two types.

1. Improve Range Condition

This type of project is designed to reduce the time necessary to change a site in poor range condition to one near its potential, or, bridge the stages of secondary succession.

Seed mixtures used to improve range condition must recognize present site potential and not be based on the virgin soil conditions. Many of New Mexico's rangelands have been changed by erosion, soil deposition and other factors. This changes the species to be used.

In this type of seeding, the user must determine the highest condition class that can be properly managed and maintained which will fill his objectives. In most cases this will be high good or excellent range condition. The seeding should be a mixture of climax native species that will provide the desired composition.

Mixtures of native species that best represent the climax composition for the present site conditions make the most complete use of the soil and climate available. The proper mixture of shallow and deep rooted and cool and warm season plants can better utilize summer and winter moisture that occurs as light showers and heavy soaking rains.

Inclusion of rapidly establishing introduced species (such as crested wheatgrass) in a slow establishing native mixture (such as sideoats grama and western wheatgrass) is usually detrimental. The competition from the rapidly establishing plants reduces the density of the native species. It also increases the rest period required for the plants to become established well enough to be properly grazed. Management of a mixture of introduced and native species is normally more difficult than either one alone.

2. Special Use Seedings

Many operating units benefit from areas seeded to a plant that fills a need not met by other available vegetation. This need includes cool season forage;

high producing, short season plants for breeding or weaning pastures; habitat to meet wildlife needs, etc.

A single species seeding of an adapted plant with the desired characteristics usually will best fill the special use purposes. The special need is most often of short time duration during the same season each year. Therefore, a single species selected to grow rapidly during this period can make good use of the accumulated moisture and fertility.

Since grazing of special use pastures is usually of short duration, intensive grazing management systems on dry rangelands are more difficult to operate than on long season native range areas. For this reason the ease of managing a single species is an important benefit.

Many introduced single species plantings are short lived in New Mexico, and thus they require periodic reseeding. Therefore, special use pastures should usually be located on the best soils available to the operator.

C. Improve Wildlife Habitat

Seedings may be designed to improve existing wildlife habitat or develop new feed and cover areas. Guidance on habitat improvement is contained in Committee Report No. 9, "Game Range Improvement in New Mexico".

It is often desirable to include tall species in wildlife seedings to provide cover and nesting areas for small mammals and birds. These cover plants serve the purpose better if they are less palatable to livestock than other species in the pasture.

IV. Factors Influencing Treatment Recommendations

A. Land Use and Maintenance Objectives

Range seeding is only one form of range improvement. To be successful, seeding must be properly planned and correlated with related range improvement practices. It is particularly essential that adequate waters and fences be in place prior to seeding. These improvements provide for protection of the seeded area during seeding establishment and proper grazing management of established stands.

An acceptable level of management should be expected and planned before any seeding is done. The seeding should fill a need and fit into the management system for the entire operating unit.

B. Present Vegetation

The existing vegetation on an area is a good clue to determining the site's potential, and thus to the alternatives for seeding. The present plant cover suggests the proper seedbed preparation, and often seeding equipment to be used.

Wildlife and aesthetic values of an area's present vegetation should be evaluated during the project planning stage.

It would be desirable to have information on the nature of secondary succession for the soils and areas being considered for treatment.

C. Soil

Soils influence areas for treatment, species to be used, seeding methods, site preparation and even expected results. Therefore, recommendations should be based on soil surveys and tests.

D. Climate

The major climatic items for consideration in designing a reseeding project are:

1. Amount and distribution of precipitation

2. Amount and season of erosive and drying winds

3. Temperature extremes, especially at the soil surface

4. Frost-free period

The climatic conditions for the treatment areas used in this report are included in Section II B, pages 7 to 14.

E. Topography

Topography relates to seeding recommendations in the following ways:

1. Steep, erosive sites should not be exposed to erosion for prolonged periods of time during seedbed preparation. In many cases related structural practices or other measures may need to be included to protect steep slopes during the establishment of the new vegetation.

2. The exposure of steep slopes, especially in the mountainous areas, will influence the species selected for seeding. In general, more drouth-tolerant plants should be used on south and west facing slopes than those on the east and north slopes.

3. It is common for soils on steep slopes to be shallow and less productive than those on gentler topography. Therefore, economic returns from seeding these areas are often less than the returns from flatter terrain.

4. The elevational differences for the same soil are accounted for in the seeding recommendations presented here by the use of resource area delineations. The descriptions in Section II B give altitude for each recognized resource area.

F. Biotic Factors

The following are major considerations made in selecting areas and patterns for treatment:

1. All areas of high quality wildlife habitat should be retained in their present state unless seeding is planned for and expected to improve the present conditions.

2. Rodent damage, especially rabbit, to new seedlings is a major factor in stand establishment in New Mexico. Steps should be taken in cooperation with the New Mexico Department of Game and Fish or Bureau of Sport Fisheries and Wildlife to determine if control of excessive rodent populations can be accomplished. These measures should be included in seeding plans where necessary.

3. Insect damage, especially from the black wheatgrass bug and grasshoppers, should be considered in treatment planning. In areas presently infested with the wheatgrass bug, species other than crested wheatgrass, and preferably other than any wheatgrass should be considered as a major component in the seeding mix. Grasshoppers should be controlled by approved methods where their populations are such as to damage newly established stands.

G. Size and Shape of Treatment Area

It is desirable to plan range seeding in a pattern that will maintain or improve aesthetic values of the area. Usually natural appearing, undulating boundaries will give the desired effect. This appearance will result if soil boundaries are followed in the seeding process. In areas of big game habitat, treatment should be planned so as to provide escape and security to the wildlife species. As a rule this can be done in wooded areas by leaving untreated corridors at least every quarter of a mile throughout the treated area.

H. Availability of Seed Equipment

In many areas of New Mexico, equipment to properly prepare a seedbed and seed grass, forbs and shrubs is limited. There are, however, several companies available in and around New Mexico whose business is built on doing seedings. It is highly preferable to secure the proper equipment and/or people to do the seeding than to carry out the practice with improper equipment and untrained crews.

In most cases grass seed is available for seeding in New Mexico. Seed is often not available for the desired shrubs and forbs adapted to the state. If the local seed dealer in an area does not have the recommended species and variety, the person planning the seeding should contact one of the larger seed wholesalers serving New Mexico. The names and addresses of most of these are available from members of the New Mexico Interagency Range Committee.

There are a number of seed collection companies in the western United States. If these companies are advised of the need of a particular forb or shrub seed well in advance of the planned seeding date, they will normally make an effort to collect the needed material. This is not as desirable a situation as seed produced under proper agronomic conditions and with a known pedigree. There are efforts being made by a number of agencies to develop superior strains of forbs and shrubs adapted to the state. As these are released and commercially produced, they should be added to the recommended varieties included in this and other guides.

A general rule is, "Don't do the job if the tools and seed are not available to accomplish the objective of the project."

V. General Principles of Seeding

A. Remove or Reduce Plant Competition

To succeed, the removal of most plant competition is necessary. This requires most existing plants be destroyed prior to seeding. A good seedbed is one which will give the best possible moisture condition for germination and plant development. With the exception of growth denuded by construction activities, erosion or fire, every acre in need of seeding has some type of plant cover. Stands of hardy annuals and herbaceous or shrubby perennials are generally fully utilizing the available soil moisture. This plant cover must be reduced to permit seedlings of the seeded species to become well established.

B. Use of Adapted Plant Materials

The plant materials selected for seeding in a project should be compatible with all others in the seeding. They should be selected to secure the management objectives, with special consideration to the greenup date, growth period, yield potential, and compatibility of associated vegetation in the operating unit. Adapted browse species, forbs and tall grasses should be included for wildlife use where this is an objective of the seeding.

1. Species and Recommended Varieties

It is important to use only those species and varieties that are well adapted to the soil, climate and topography of the specific site being seeded. Recommended species and varieties are shown on Tables 3, 4, 5 and 6 by sub resource area and soil groups.

Improved ecotypes of many varieties of grasses used in New Mexico have been selected for outstanding characteristics. These factors include superior seeding vigor; drought disease and insect tolerance; forage production; seed production, and ability to spread vegetatively. Those few plants that carry the characteristics for which they have been evaluated are released as named varieties. The recommended variety for most species is shown for that species in the following section, and again in Table 2.

Improved named varieties are recommended whenever they are available. To assure the user that he is purchasing

the characteristics associated with a given variety, certified seed is recommended. A number of named varieties have been grown for so many generations that, through crossing and reproduction, they have lost many of the superior features for which they were originally selected. Certification is preferred because it insures genetic purity of the concerned plant.

The following gives general characteristics of grasses, shrubs, legumes and forbs commonly used in New Mexico:

a. Cool Season Grasses[1/]

The following includes some species and varieties that are not readily available:

(1) Big bluegrass (Poa ampla) (Native)
Big bluegrass is a long-lived, improved, native bunchgrass. It is well adapted for early spring grazing. It is adapted where moisture is 9 - 15 inches. Its loosely constructed bunch can be broken apart and pulled up easily. It is easily destroyed by overgrazing. It needs shallow, July or August seeding on a well prepared seedbed. It is important for early green feed for wildlife. 'Sherman' is the recommended variety.

(2) Blue Wildrye (Elymus glaucus) (Native)
Blue wildrye is a rapid developing, short-lived bunchgrass. It is shade tolerant and will grow on harsh sites. Blue wildrye has proven to be one of the least competitive grasses with tree seedlings. This is due to its growth habit and shallow compact root system. Seed is not always available.

(3) Crested wheatgrass (Agropyron desertorum) (Introduced) Crested wheatgrass is long-lived, drought-tolerant, cool-season bunchgrass. It is well adapted for early spring grazing and one of the best adapted grasses for use in the 9 to 15 inch precipitation zone where winter moisture is equal or greater than summer moisture. This grass will not do well if a restricted clay layer is within 15 inches of soil surface. 'Nordan' is the recommended variety.

1/ Species are considered introduced if they are not native to the United States. Species shown as Native may have been introduced to the state from another state.

(4) Hard fescue (Festuca ovina, var, duriuscula) (Introduced) Hard fescue is a low-growing bunchgrass adapted where the moisture is 14 - 25 inches. It has a dense and voluminous root system and gives excellent erosion control. 'Durar' is the recommended variety.

(5) Indian ricegrass (Oryzopsis hymenoides) (Native) Indian ricegrass occurs naturally on sandy soils in arid and semi-arid regions. The best use of Indian ricegrass is winter grazing. This species should be seeded alone and at a depth of about 2 inches in sandy soil. Seed is usually in short supply.

(6) Intermediate wheatgrass (Agropyron intermedium) (Introduced) Intermediate wheatgrass is a late-maturing, long-lived, cool-season mild sod-former suited for use as hay and pasture, alone or with alfalfa, under irrigation or on dryland where the moisture is 15 - 23 inches. It requires good drainage and moderate to high fertility. 'Amur' is the recommended variety.

(7) Meadow brome (Bromus biebersteinii) (Introduced) Meadow brome is a long-lived, cool-season grass adapted to high precipitation zones. It is a good forage producer suited for use as pasture or hay with irrigation or under the proper dryland conditions. Meadow brome is slower to establish than smooth brome; but it does not tend to become "sod bound" as rapidly. 'Regar' is the recommended variety.

(8) Meadow foxtail (Alopecurus pratensis) (Introduced) Meadow foxtail is a long-lived weak sod-former well adapted to wet soils, to land subject to flooding in winter or early spring, and to high altitudes. It is well suited for pasture and hay, is tolerant of prolonged snow cover, and has a long season of use with high frost tolerance. It is tolerant of strongly salty conditions and is responsive to high fertility. It is difficult to seed, requires carrier for the seed, if seeded through standard drill, or requires special seeding equipment. It spreads well into native, meadow sod. It is extremely palatable. 'Carrison' is the recommended variety.

(9) Mountain Brome (Bromus marginatus) (Native)
Mountain brome is a rapid developing short-lived, shade-tolerant grass. It is used primarily for soil stabilization in the higher elevations where rainfall is above 18 inches. Seed is not always available.

(10) Orchardgrass (Dactylis glomerata) (Introduced)
Orchardgrass is a long-lived, high-producing bunchgrass adapted to well drained soils under irrigation or on dry land where the moisture is 18 inches or more. It is shade-tolerant and suited for pasture, hay or silage. It is a good wildlife species and adapted to the timbered areas of the Southwest. 'Potomac' and 'Latar' are the recommended varieties.

(11) Perennial ryegrass (Lolium perenne) (Introduced)
Perennial ryegrass is a rapid maturing, short lived sod-former adapted to a wide variety of soil conditions where the moisture is 15 inches or more. It may retard establishment of other perennials if seeded too heavily in a mixture. It has good recovery after grazing in the spring, but tends to go dormant in summer. It is excellent for soil stabilization.

(12) Pubescent wheatgrass (Agropyron trichophorum) (Introduced) Pubescent wheatgrass is a long-lived, cool-season sod-former adapted to low fertility sites and fine textured soils where moisture is 12-15 inches. It will tolerate more alkali and drier conditions than intermediate wheatgrass. 'Luna' is the recommended variety.

(13) Reed canarygrass (Phalaris arundinacea) (Native)
Sod former
Reed canarygrass is a long-lived ~~bunchgrass~~ especially suited for use on extremely wet land or where prolonged inundation occurs. Uniform utilization is a common problem because of the conditions under which it is used. It is suited for pasture or conservation plantings but can be a serious weed in irrigated areas. 'Ioreed' is the recommended variety.

(14) Russian wildrye (Elymus junceus) (Introduced)
Russian wildrye is a long-lived drought-tolerant

bunchgrass. It establishes slowly, but will persist after establishment. It is best suited to the pinyon-juniper zone in the 12" - 14" rainfall belt where summer moisture is dominant over winter moisture. 'Vinall' is the recommended variety.

(15) Siberian wheatgrass (Agropyron sibericum) (Introduced) Siberian wheatgrass has the same general characteristics as crested wheatgrass. It is considered to be slightly more drought-tolerant than crested, especially on coarse textured or sandy soils. 'P-27' is the recommended variety.

(16) Slender wheatgrass (Agropyron trachycaulum) (Native) Slender wheatgrass is a relatively short-lived, cool-season bunchgrass adapted where the moisture is 18 - 22 inches. It is tolerant of moderately alkaline conditions. Its main use is for erosion control. 'Primar' is the recommended variety.

(17) Smooth brome (Bromus inermis) (Introduced) Smooth brome is a long-lived, cool-season, mild sod-former adapted to well-drained soils above 6,000 feet elevation where the moisture is 25 - 35 inches. It is a good forage producer suited for use as pasture or hay with irrigation or dryland conditions. It does not have suitable longevity under pasture use when mixed with other plants because of its extreme palatability. 'Lincoln' and 'Manchar' are the recommended varieties above 8000 feet. 'Lincoln' should be used below 8000 feet.

(18) Streambank wheatgrass (Agropyron riparium) (Native) Streambank wheatgrass is a cool-season, moderately long-lived, sod-forming grass suited for critical area stabilization. Although it is native to Colorado and other mountain states, it has been introduced to New Mexico for use where a semi-unpalatable species is desired. It should be seeded as a single-species planting unless mixed with plants for beautification or browsing. 'Sodar' is the recommended variety.

(19) Tall fescue (Festuca arundinacea) (Introduced)
Tall fescue is a long-lived, cool season, salt-tolerant grass adapted to wet areas and ones with precipitation of over 24 inches. It is a good forage producer well suited to pasture when seeded alone. Its palatability is not as good as some other species. 'Alta' is the recommended variety.

(20) Tall oatgrass (Arrhenatherum elatius) (Native)
Tall oatgrass is a long-lived, rapid developing bunchgrass well adapted to low fertility soils. It is best suited on dryland where the moisture is 18 inches or more. Its large seed makes it a desirable species for wildlife plantings. It will not persist under heavy grazing. It is tolerant of shade and recovers rapidly after clipping or grazing. 'Tualatin' is the recommended variety.

(21) Tall wheatgrass (Agropyron elon gatum) (Introduced)
Tall wheatgrass is a tall-growing, cool-season, long-lived bunchgrass suited for hay or pasture under irrigation or on dry land where the moisture is 16 - 20 inches. Once established, it is tolerant of strongly to very strongly salty conditions -- one of the most tolerant of all forage grasses, especially to clayey salty soils. It does not withstand close grazing. 'Jose' is the recommended variety.

(22) Thickspike wheatgrass (Agropyron dasystachyum) (Native) Thickspike wheatgrass is a long-lived, cool season grass adapted to areas of over 14 inches precipitation. It is slower to establish than most introduced wheatgrasses, but better suited to sandy sites than most. 'Rosana', which is rhizomatous, is the recommended variety for critical areas.

(23) Timothy (Phleum pratense) (Introduced)
Timothy is a short-lived perennial adapted to high elevations and where moisture is 18 inches or more. It is suited for forage and erosion control, and has special value in revegetating forested lands. 'Climax' is the recommended variety.

(24) Western wheatgrass (Agropyron smithii) (Native)
Western wheatgrass occurs most frequently on clay soils. It can grow through thick layers of silt. Western wheatgrass is strongly rhizomatous and is a very good erosion control plant. 'Barton' for the plains area and 'Rosana' for the mountains are the recommended varieties.

b. Warm Season Grasses

(1) Alkali sacaton (Sporobolus airoides) (Native)
This grass is a coarse, densely tufted bunchgrass found on fine textured saline or alkali soils. It is especially useful where wind erosion occurs. The forage is rated good when it is growing vigorously. This grass is resistant to silting, making it ideal for eroding bottoms. It is difficult to establish stands from seed.

(2) Arizona fescue (Festuca arizonica) (Native)
Arizona fescue is a long-lived, slow establishing bunchgrass native to the ponderosa pine and mixed conifer zone. Although it has a medium grazing preference, it is an important livestock forage species because of its high production potential. Arizona fescue is also a desirable erosion control plant. Good stands have been established in several tests in New Mexico. Seed should become available in limited amounts in 1975.

(3) Bermuda grass (Cynodon dactylon) (Introduced)
Bermuda grass is a leafy perennial sod-former. It will not tolerate cold temperatures, but is one of the most salt tolerant grasses. It is best adapted to bottomlands below 4500 feet. Bermuda is a good erosion control plant and may be used as a turf grass. 'Midland' gives good performance.

(4) Big bluestem (Andropogon gerardii) (Native)
Big bluestem is a long-lived, warm season sod former. It occurs native in the mountain grassland and sub-irrigated sites of New Mexico. Big bluestem should be used only in seeding mountainous and wet meadow sites. It is a livestock-preferred species. 'Kaw' is the recommended variety.

(5) Black grama (Bouteloua eriopoda) (Native)
Black grama is widespread in the Southwest and is one of the best forage plants in this area. The plants are tufted, 1 to 2 feet tall, long-lived, and have branched, decumbent and creeping stems which often root at the joints. This method of spreading is the chief manner in which black grama perpetuates itself. Normally it is a very poor seed producer. Black grama is at home on medium to coarse textured soils. It is nutritious at all seasons of the year and is relished by all classes of livestock. Because of solid culms that remain green during the dormant season, black grama is most palatable during the winter. Rangemen list it as a decreaser in all range sites where found. Its use in range seeding is well indicated. 'Nogal' is the recommended variety. Seed is usually in short supply.

(6) Blue grama (Bouteloua gracilis) (Native)
Blue grama is a long-lived short grass preferring medium to fine textured soils. It is a fast summer grower requiring good summer moisture. At higher elevations this grass becomes turfy and very low in production. 'Lovington' is the recommended variety.

(7) Blue panicgrass (Panicum antidotale) (Introduced)
Blue panicgrass is a branching leafy perennial sod-former grass. It grows 4 to 5 feet tall. It will not stand cold winters. It may have a place in draws and areas where moisture concentrates at the lower elevations.

(8) Boer Lovegrass (Eragrostis chloromelas) (Introduced)
Boer lovegrass is a fairly long-lived, warm season bunchgrass, heading at about 36 inches and having a characteristic blue-green foliage. It is more palatable than either Lehmann or weeping lovegrass. However, seedling vigor and ease of establishment is inferior to either of these two introduced lovegrasses. It has been widely tested in field evaluation plantings. Winter killing is probably the main cause in eliminating plants in the more northern test sites. This grass has a place in the sandy lands of southeastern New Mexico. 'Catalina' is the recommended variety.

(9) Bush muhly (Muhlenbergia porteri) (Native)
Bush muhly is a highly palatable, warm season grass native to the southwestern United States. It is found mainly in gravelly washes and dry hillsides of the southern desert land, and then mainly in the protection of bushes, and is nowhere abundant. It has long trailing stems which remain green through most of the winter if temperatures are not too severe. Because of its drought resistance, it has the ability to survive and grow in some of the toughest sites in the Southwest. Seed is usually not available and it is difficult to establish.

(10) Galleta (Hilaria jamesii) (Native)
Galleta is a slow establishing, long-lived, sod-forming grass native to the northern 2/3 of New Mexico. It affords moderately good forage for livestock during the growing season, but is rather poor when it is dry. Galleta is an excellent erosion control plant because of its vigorous rhizomes. Good seed is usually not available.

(11) Havard panic (Panicum havardii) (Native)
Havard panic is a moderately long-lived, tall sod-forming grass native to sandy sites in southern New Mexico. It provides good livestock forage and is often removed from areas by continued overuse. It is an excellent erosion control plant when properly managed. Seed is usually not available.

(12) Indiangrass (Sorghastrum nutans) (Native)
Indiangrass is a long-lived, warm season, moderately rhizomatous native. It occurs in sandy soils above 16 inches precipitation, sub-irrigated valleys, and in the Ponderosa pine zone of several of New Mexico's mountain ranges. Its use in seeding programs should be confined to sites similar to its native habitat. It is highly palatable to livestock. 'Llano' is the recommended variety.

(13) Lehmann Lovegrass (Eragrostis lehmanniana) (Introduced) Lehmann Lovegrass is a drought-tolerant warm season bunchgrass. It is the most reliable grass for seeding poor condition range areas in the basin area of southeastern Arizona

and southern New Mexico. It should be used at elevations below 4500 feet. Lehmann lovegrass is rather easy to establish and grows on a variety of soils with rainfall below 12 inches. This grass should be seeded alone and managed on an intensive pasture basis. For areas above 3000 feet elevation and with 13" or more rainfall, seed can be broadcast, although drilling gives the best results.

(14) Little bluestem (Andropogon scoparius) (Native)
Little bluestem is a long-lived, drought-resistant warm season bunchgrass. It is native on the sandy, calcareous loams and shallow soils in the eastern one-half of the state. It occurs frequently in the Ponderosa pine zone. It is considered a desirable livestock graze which commonly forms "wolf plants" because of selective grazing. This plant is well adapted to soils with low fertility, and therefore is suitable for mixes on critical area stabilization sites. 'Pastura' is the recommended variety.

(15) Plains bristlegrass (Setaria macrostachya) (Native)
Plains bristlegrass is a moderately long-lived, warm season bunchgrass. It is native throughout much of eastern and southern New Mexico, in sandy and sandy loam soils. In many areas the only remaining native plants are protected from grazing by brush species. Although it is a highly desirable plant for rangeland seeding, adapted seed is often in short supply.

(16) Sand bluestem (Andropogon hallii) (Native)
Sand bluestem is a long-lived, tall growing sod-former. It is native to the sands in the areas above 14 inches precipitation in eastern New Mexico. It is highly preferred by livestock, and should be used on dry lands in a mixture. 'Elida' is the recommended variety.

(17) Sand dropseed (Sporobolus cryptandrus) (Native)
Sand dropseed is a bunchgrass with a wide range of adaptability. It is most suitable for well-drained, sandy soils. It is best adapted in the 9-14 inch rainfall belt where summer moisture exceeds winter moisture and up to elevations of

7,500 feet. It can survive rather severe drought conditions. This grass should be included in most mixtures on critical areas.

(18) Sand lovegrass (Eragrostis trichodes) (Native)
Sand lovegrass is a relatively short-lived, early warm season bunchgrass. It is native to the sands and loamy sands in northeastern New Mexico. It is quite palatable to livestock, but normally hard to manage after maturity. It is recommended for sandy rangelands above 16 inches precipitation, as a minor part of native grass mixtures, or as special use native pastures. 'Bend' is the recommended variety.

(19) Sideoats grama (Bouteloua curtipendula) (Native)
Sideoats grama is a long-lived warm season midgrass. It is normally a bunchgrass, but does have short root stocks. It prefers medium or coarse textured soils. Elevational range is up to 8000 feet. It should be used where summer moisture is dominant. 'Vaughn' is superior where adapted. 'El Reno' is suited for range interseeding and other sites where vigorous rhizomes are desired.

(20) Spike muhly (Muhlenbergia wrightii) (Native)
Spike muhly is a long-lived, warm season bunchgrass growing to a height of 30 inches under good conditions. The stems are somewhat spreading at the base, leafy, smooth and somewhat flattened. Leaves are fairly long but narrow, and inclined to be tough and wiry. The seedhead is spikelike, sometimes causing the observer to confuse the species with wolftail or Texas timothy. It is widely distributed in the pinyon-juniper belt and extends to higher elevations in pine grasslands and mountain valleys. It prefers medium to fine textured soils including shale-derived soils.

(21) Switchgrass (Panicum virgatum) (Native)
Switchgrass is a long-lived, semi-drought-tolerant, warm season sod-former. It is adapted to sandy soils and precipitation zones about 16 inches, to loamy or sandy soils in wet meadows, and to shallow or loamy soils at elevations between 7,000 and

9,000 feet. When proper equipment is used, it is normally easy, though slow, to establish. It is a plant highly preferred by livestock. 'Blackwell' is the recommended variety.

(22) Tobosa (Hilaria mutica) (Native)
Tobosa is a long-lived, sod-forming, mid grass native to the southern half of the state. It grows best on fine textured soils subject to flooding. While growing, tobosa is palatable to livestock. It provides little winter feed. It provides good erosion protection and is moderately salt-tolerant. Good seed is usually not available.

(23) Vine-mesquite (Panicum obtusum) (Native)
Vine-mesquite is a fairly long-lived, warm season grass. It spreads by means of underground roots. It is adapted to a variety of soils, but found most abundantly in flood plains, depressions and swales. It is one of the most valuable grasses for use in stabilizing waterways, waterspreading areas, and for healing small gullies and banks on medium to heavy soils. It spreads rapidly by stolons which root at the nodes. Established plants can withstand some silting. Palatability is high when plants are in succulent growth, but lessens as maturity is reached. Good seed is usually not available.

(24) Weeping lovegrass (Eragrostis curvula) (Introduced)
Weeping lovegrass is a native of South Africa. It is a densely tufted, warm season perennial. It grows to a height of 3 to 4 feet, has a heavy fibrous root system and an abundance of long, thin, weepy leaves growing from the base of the plant. A solid stand of the species provides excellent protection to soil from both wind and water erosion. Similar to most grasses, it makes its best growth on good fertile soil. It is not restrictive in soil requirements, and is well adapted to sandy soils depleted in organic material and fertility. Though herbage is produced in abundance, it is not tender and succulent. Due to the drooping characteristic of the foliage, it provides excellent cover and food to small game. Weeping lovegrass has shown longevity

when seeded and managed as a single species. This grass requires intensive pasture management to produce its maximum.

(25) Wilman lovegrass (Eragrostis superba) (Introduced) Wilman lovegrass is a warm season, leafy bunchgrass. It grows well during the early spring and furnishes an abundance of forage. It is damaged by cold weather, but will stand temperatures as low as 15° Fahrenheit. It looks promising as early green feed for wildlife. 'Palar' is the recommended variety.

(26) Yellow bluestem (Bothriochloa ischaemum) (Introduced) Yellow bluestem is often called caucasian bluestem. It has given good results in southern Great Plains seeding trials. It is vigorous and high yielding in forage. It volunteers readily. This grass has a place in erosion control, especially in road cut and fill seedings. Seed of varieties adapted to southern New Mexico is not readily available.

In addition to having hard seed, all lovegrasses have a delayed germination. Seed that is at least one year old should be used.

c. Forbs

The seed of all legumes should be inoculated with the proper nitrogen-fixing bacteria before planting. This is important for the nitrogen production of these plants. Most range soils do not naturally contain these bacteria, as they have to be introduced with the seed. Follow directions on the package for mixing and storage of seed which has been treated with the nitrogen bacteria.

(1) Alfalfa (Medicago sativa) (Introduced) Alfalfa is a perennial legume with numerous varieties, each of which has special characteristics for a given purpose. It is suited for use as hay or pasture on dryland where the moisture is 15 inches or more. In general, those that are winter-hardy show less regrowth after cutting. Alfalfa used should be resistant to bacterial wilt.

Moderately winter-hardy varieties are suited for the colder portions of the Southwest. Use "AB" type inoculant for all alfalfa.

(a) Ladak. Ladak is best suited of all alfalfa varieties for dryland seedings. It recovers slowly after grazing and is moderately wilt-resistant and very winter-hardy.

(b) Nomad. Some Nomad plants are upright, others decumbent and spreading. Some plants have well developed rhizomes, others do not. Where rhizomes exist, the plant can withstand some rodent damage to the crown. Nomad is susceptible to bacterial wilt.

(c) Rambler. Rambler is creeping-rooted under some conditions. Most forage is obtained in first cutting. It is moderately resistant to bacterial wilt, but very winter-hardy.

(2) Big trefoil (Lotus uliginosus)
Big trefoil is a long-lived legume suited for use as pasture and hay under wet-land conditions. It withstands considerable inundation and is not winter-hardy. 'Marshfield' is a recommended variety.

(3) Birdsfoot trefoil (Lotus corniculatus) (Native)
Birdsfoot trefoil is a long-lived, deep-rooted legume suited for use as pasture on dryland where the moisture is comparable to 18 inches or more. This species is slow to establish and requires a special inoculant. It does not create bloat problems and is very winter-hardy. Use "C" type inoculant. Recommended varieties are:

(a) Granger and Cascade. Broadleaf. It is generally more vigorous than narrowleaf trefoil, and is adapted for use on moderately alkaline to medium acid conditions and at higher elevations.

(b) Narrowleaf (no named variety). Narrowleaf produces well on clayey soils.

(4) Black medic (Medicago lupulina) (Introduced) Black medic is a European annual which is now found in areas of over 16 inches precipitation. It reseeds readily and is of value as a cover and pasture plant. Its spreading habit provides good initial stabilization on critical sites at higher elevations. The seed and leaves are used by wildlife.

(5) Burnet (Sanguisorba minor) (Introduced) Burnet, a forb belonging to the rose family, was introduced from Europe. Burnet is a very palatable plant and is heavily used by rabbits, deer and elk. The rosettes of Burnet are grazed heavily by wildlife during late April, May and June. Burnet also stays green and palatable under snow for a short time, but tops freeze if the soil freezes. Seeds are used by upland game birds for food.

The plant generally grows to a maximum height of 18 inches and spreads out 9 to 12 inches at the base. It is succulent and appears to be fairly drought-resistant. In a mixture of grasses and other forbs, it seems to be a rather poor competitor, and will disappear in three to eight years if competition for water is intense. One of its outstanding values is its ability to establish on harsh sites under conditions where other plants will not germinate or survive.

(6) Cicer milkvetch (Astragalus cicer) (Introduced) Cicer milkvetch is a moderately long-lived non-bloat legume from Eurasia. Its growth habit is decumbent to upright. It is adapted to areas with over 18 inches annual precipitation. It provides excellent livestock and wildlife forage and is good for soil stabilization. Seed must be properly scarified shortly before planting to establish suitable stands. 'Lutana' is the recommended variety.

(7) Rocky mountain penstemon (Penstemon strictus) (Native) Rocky mountain penstemon is an attractive, erect forb growing to a height of 16 to 24 inches. It is native to the pinyon-juniper and ponderosa pine zones of New Mexico. It has a basal rosette which remains green during the winter. This contributes to its ability to stabilize erosive sites. Rocky mountain penstemon has been successfully seeded in New Mexico trials. A limited amount of seed should be available after 1975.

(8) Sainfoin (Onobrychis viciaefolia) (Introduced) Sainfoin is pinkish flowered, short-lived, non-bloat legume introduced from southern Europe. It is an excellent livestock and wildlife forage. In most seedings it has maintained an ample stand for only 4 to 6 years. Therefore, it is not well suited to erosion control.

(9) Strawberry clover (Trifolium fragiferum) (Native) Strawberry clover is a spreading pasture-type perennial suited for pasture use under semi-wet, strongly to very strongly acid conditions. It is less productive than white clover where the latter can be grown.

(10) Sweetclover (Melilotus sp.) (Introduced) Sweetclover is a tall-growing, stemmy annual or biennial legume suited for pasture, on dryland where the moisture is 12 inches or more. Use "AB" type inoculant.

Biennial: Madrid is yellow flowered. Spanish is white flowered. Madrid is earlier maturing, less productive under optimum growing conditions, and more suited for use on sandy soils or in drier conditions.

(11) White clover (Trifolium repens) (Native) White clover is a long-lived perennial legume suited primarily for pasture on dryland where the moisture is 16 inches or more. It requires medium to high fertility and adequate moisture for optimum production. It is not tolerant of strongly acid nor strongly alkaline conditions. Use "AB" type inoculant.

d. Shrubs

(1) Antelope bitterbrush (Purshia tridentata) (Native) Antelope bitterbrush is native to northwestern New Mexico's foothills and mountain slopes. It is best adapted to well-drained sandy, gravelly or rocky slopes. Antelope bitterbrush is an important browse plant for both wildlife and livestock. Establishment of trial stands from direct seeding has had some success. Live plants have been successfully transplanted in some areas. Seed is in short supply.

(2) Apache plume (Fallugia paradoxa) (Native) Apache plume is native along many drainages and in gravelly soils in New Mexico. It is common at elevations of 5500 to 8500 feet. Apache plume is a suitable browse plant for wildlife and livestock. It is able to withstand excessive silting and therefore should be considered a desirable erosion control plant. Establishment from direct seeding is difficult. Live transplants may be used successfully. Seed is usually not available.

(3) Fourwing saltbush (Atriplex canescens) (Native) Fourwing saltbush, often called "Chamiza" is a grayish white, freely branched shrub, from 2 to 6 feet in height and 3 to 8 feet in diameter. The leaves are scurfy, stemless, somewhat fleshy, usually linear and up to 2 inches long. It is found in all areas of New Mexico except the higher portions of the Rocky Mountain area. It characteristically inhabits dry, moderately saline or alkaline soils of drainages and foothill regions, and frequently is the dominant species over extensive areas. It grows best on soils of a basic or calcareous nature. Fourwing saltbush is perhaps the most important browse shrub of the Southwest, and is certainly one of the most palatable. The seed should be planted ½ inch to 1 inch deep. Seed is in short supply.

(4) Mountain mahogany (Cercocarpus montanus) (Native) Mountain mahogany is an important

browse for both livestock and wildlife in the southwest. It occurs on dry, rocky mountain slopes and prefers limestone-derived soils. Some success has been achieved from May-June seedings. Some seed collection is made each year using a vacuum type machine, but it is usually in very short supply.

(5) Rubber rabbitbrush (Chrysothamnus nauseosus) (Native) Rubber rabbitbrush is often considered to be an undesirable shrub on New Mexico's rangelands. In contrast, it is considered a valuable shrub for wildlife and range improvement in Utah. It is being given increased consideration in New Mexico as a plant for critical area stabilization and landscaping where other shrubs will not grow well. These are often salty sites or those with low fertility. Seed is usually unavailable. Before recommending rubber rabbitbrush the points in paragraph 5-B-3 should be considered.

(6) Winterfat (Eurotia lanata) (Native) Winterfat occurs on dry sandy or shallow clay soils. It is a low shrub, very valuable for livestock and wildlife. Winterfat should be seeded in late fall or winter soon after collection. The seed should be covered with less than ¼ inch of soil. Seed is in short supply.

2. Source of Seed

In all cases seed should come from a source adapted to the climate and soil in which it is being planted. Suitable genetic origin for species such as named varieties should be used if available. Climatic adaptation of native species is often satisfactory if the origin is from the same or a similar land resource area, and not in excess of approximately 300 miles south or about 200 miles east, west or north. A satisfactory genetic adaptation includes seed from stands that are reasonably pure, and that have growth characteristics representative of the species concerned. Certified named varieties should be used in preference to others, when available.

3. Undesirable Species

Some plants serve a useful purpose when they grow on a given site, but are highly undesirable when they escape to adjacent areas. In many cases, such as rubber rabbitbrush, control of the species after it becomes a weed is difficult. Therefore, good judgment must be exercised in selecting species, especially shrubs, for a treatment project. If non-weedy species are available and adapted, they should be used rather than another plant that may escape and cause problems.

C. Seeding Rates and Pure Live Seed

It is important to use enough seed to get a good stand, but not more than necessary. Too much seed may produce a stand of seedlings so thick that individual plants may compete with each other to the detriment of all. Species of grass, number of pure live seeds per pound, and potential productivity of the site are the major factors in determining the rate of seeding. More pounds per acre are required for large seed species such as bromegrass and pubescent wheatgrass than for such small seeded species as timothy and hard fescue. Since seeding rate is important, it is advisable to use up-to-date germination information. This is especially true when seed is held in warehouses for more than one year. Seed should be stored in cool, dry places. Some seed lots decline rapidly in viability; consequently as the seed gets older, more pounds per acre will be needed to provide the same number of pure live seed. Germination tests may be obtained from the State Seed Laboratory operated by New Mexico State University. County Extension agents can provide details about the use of this laboratory. As a general rule, rapidly developing short-lived grasses will lose viability faster than those of a slow developing, long-lived species.

Pure live seed (PLS) should always be the basis of establishing seeding rates. PLS is determined by multiplying the germination of a lot of seed by the purity. For example, a 100 pound bag of seed with a germination of 50% and a purity of 80% would be computed thus: 50% x 80% = 40% PLS. This means that from a 100 pound lot of seed, only 40 pounds would be pure viable seed. To establish a suitable stand of this quality of seed, a person would need to seed 2½ times the number of bulk pounds to achieve the desired PLS seeding rate. All seeding recommendations in this report are based on PLS.

1. Drilled

In most cases seeding rates are established that provide 20 to 25 seeds per square foot when placed in soil through a drill. There are some species, such as buffalograss, which is rapidly spreading, where a lighter seeding rate is often used. For extremely small seed species such as weeping lovegrass, a heavier seeding rate is commonly used. A lighter seeding rate may be used in dry areas where the expected stand would be fairly sparse. In contrast, wet meadow sites with a high productive potential may use a heavier seeding rate.

2. Broadcast

Broadcast is an inefficient method of seeding. Many individual seeds are perched on top of the soil, where germination and seeding establishment are difficult, if not impossible. Therefore, a seeding rate twice that of the drilled rate (40 to 50 seeds per square foot) should be used with any form of broadcast seeding. If the seeds are particularly large in size, a seeding rate more than double that of drilling is recommended. Very small seeds may not need quite the double seeding rate. Seed which is broadcast should always receive some mechanical treatment to give suitable coverage. The only exceptions would be seeding in fresh cool ashes, or immediately following mechanical disturbance, where sloughing of soil during the first rain will provide some coverage.

3. Critical Areas

The drilling rate on critical areas (all areas which exhibit special establishment problems because of extreme slope, low fertility and other situations resulting from construction and excessive erosion) should be double that of rangeland drilled rate, or 40 to 50 seeds per square foot. Seed broadcast on critical areas should be applied at the rate of approximately 60 seeds per square foot. On critical area sites where excessive runoff moisture is expected, the seeding rate should be increased even more, if the seeds are not properly covered.

4. Mixtures

In developing seed mixes, the percentage of each included species should first be determined. This

percentage, which should total 100, is then multiplied by the recommended seeding rate for the concerned species. This will give the required pounds PLS for that species in the mix. Since all seeding rates in this report are for drilled rangeland conditions, the resulting pounds needed in a mixture should be proportionately increased for broadcast and critical area situations.

Example:

Seeding rates given are for straight seeding for the species. Seeding rates are acceptable if they are within a range of 80% to 125% of the rate given. Reduce seeding rates for mixtures in proportion to the percentage of each species to be planted in the mixture. Example for a seeding mixture for a loamy site planned for sideoats grama, western wheatgrass, and blue grama:

	Seeding Rate	Percent of Mix
'Vaughn' Sideoats grama	4 lb.	40% of 4 - 1.60 lb. PLS
'Barton' Western wheatgrass	8 lb.	20% of 8 - 1.60 lb. PLS
'Lovington' Blue grama	1.5 lb.	40% of 1½ - 0.60 lb. PLS
		Total Seed - 3.80 lb. PLS

D. Depth of Seeding

Plant each species at its proper depth. For optimum emergence, small-seeded species such as timothy and orchardgrass should not be planted deeper than one-fourth inch, whereas such species as smooth bromegrass and crested wheatgrass do best when seeded at a depth of one-half to three-fourths of an inch. Optimum depth of seeding is roughly proportional to seed size. A rule is to seed 4 to 7 times the diameter of the seed. Plantings in the spring should generally be deeper than those in the fall. Plantings can be deeper in light, sandy soils than in the heavier clay soils. Where a mixture of small-seeded and large-seeded species is planned, seed to the depth directed by the small-seeded species. Indian ricegrass does well planted about 3 inches deep in sand.

Seeding equipment should be used that provides for positive seed placement at the desired depth. Equipment should not be of a type that will allow rain or wind to cover the seed to an excessive depth. It is not uncommon to be able to see some seed on the surface when it is placed at the proper depth. More stands are lost because seed is planted too deep than too shallow.

E. Seed Distribution

Uniform distribution of seed is essential. Proper seeding rate per acre but poor distribution will result in too much seed in one spot and not enough in another. This is often the result when seed is broadcast by airplane, by hand, or with a motorized broadcaster unless care is taken and the relative distribution of the seed checked frequently. The most uniform distribution of seed is gained through the use of a drill, or drill-like seeder box. These should be used whenever possible.

Even in drilling, care should be taken to constantly check the performance of the drill; some furrow openers may clog or seed may slide to one side of the drill box on sloping land.

In seeding mixtures made up of species with seed of widely different sizes, the smaller, heavier seeds generally sift to the bottom of the drill box or broadcaster hopper; and the larger, lighter seeds sift to the top. This results in poor distribution of each species even though the overall rate per acre may be satisfactory. This can be avoided when drilling by putting the smaller seeded species in the small seed box attachment and running the larger seeds through the main grass seed box. A filler, such as rice hulls or rolled barley, may be added to seed mixture to minimize sifting in broadcast hoppers.

F. Seeding Dates

The most desirable time to do range seeding is immediately prior to the season of the highest expected precipitation. There are a number of precipitation probability tables now available to use in the selection of a seeding date. These tables show the probability of receiving a given amount of precipitation during any given period for long-established weather stations throughout New Mexico.

New Mexico's precipitation pattern shows the greatest moisture comes throughout most of the state in July, August and September. Where this pattern exists, seeding may be done from June 15th to approximately July 15th for warm season grasses, and as late as early August for cool season grasses. A person should plan to have a project completed at least 45 to 60 days before the expected long dry period or freezing weather. Where broadcast seeding is done in conjunction with fire, brush control or other mechanical

disturbance, the seeding may be done at the time of disturbance. Results, however, will be most successful if the mechanical treatment is timed to allow seeding just before the expected precipitation period. Table 2 shows the recommended seeding dates for the sub resource areas.

G. Operation of Seeding Equipment

Operation of seeding equipment is a very important item in any seeding job. Since any seeding job is an expensive undertaking, it is essential that the final stage, the actual seed planting, be done properly. The operation of the drill must be watched closely to prevent malfunction which can result in no seed being applied, uneven distribution of seed, or too much seed being applied. Depth of planting must also be closely watched. The speed of operation is important. Moving too fast will result in bouncing of the drill, uneven distribution and poor coverage. It is also important in the arid west to drill on the contour whenever possible. The small amount of added moisture caught in a contour furrow may mean the difference between germination and no germination. A well trained operator is essential to success.

VI. Seedbed Preparation

A. Cover Conditions

1. Perennial Vegetation

Several opportunities exist for preparing a suitable seedbed in perennial vegetation.

a. Chemical

If the perennial vegetation is predominantly broadleaf plants or other vegetation which can be controlled by chemical, the area may be treated to kill or reduce the existing competition. The desired plants can then be drilled directly into the dead perennial vegetative cover.

b. Mechanical

(1) Areas of undesirable perennial vegetation that provide an adequate litter on the soil may be

undercut with sweeps or other suitable machinery. This will sever the root below the soil surface and leave most of the vegetation in place. The treatment may then be done in existing dead surface litter.

(2) Perennial vegetation such as sagebrush may be plowed, mowed, or otherwise machanically killed. In areas where wind and temperature are not important factors, the seed of the desired plants can then be drilled directly into the remaining soil after it has had ample time to become firm.

(3) Perennial cover can be killed in strips, such as is done with the range interseeder. The seed can then be drilled in the strips where competition has been destroyed, leaving undisturbed vegetation in between the newly established rows.

2. Annual Weed Cover

Drilling grass seed into existing annual weeds is acceptable when all of the following conditions are met:

a. The soil is firm.

b. Weedy vegetation is dead, and small for the species.

c. There is sufficient cover over the entire area to protect it from wind erosion after seeding operations. (Normally greater than 500 pounds of litter is required on loamy soils, and 1,000 pounds on loamy sands and sandy loams.)

d. Perennial species do not occur in sufficient amounts to offer excessive competition with seeded species--usually less than 15% of the annual production.

e. Following seeding, weeds should be controlled until grass is established.

B. Prepared Cover Crop

1. Seedbed Preparation: A well prepared seedbed must be completed prior to planting the cover crop. Normal seedbed preparation as required for crop production will be necessary. Minimum seedbed preparations are as follows:

a. Till with sweep, chisels, disc, or plow to minimum of 3" deep.

b. Tillage should be done in spring as soon as annual weeds begin using appreciable moisture, but not later than June 1. The windy season common to most of the state should be avoided.

c. Additional shallow tillage will be necessary if annual weeds persist until seeding time.

2. Planting Methods and Date: The crop will be drilled or planted in rows spaced not more than 24 inches apart. Optimum spacing is about ten inches between drill rows. Planting depth should be 1 inch to 2½ inches depending upon soil texture. Seeding date will be June 1 to July 15 for warm season crop and August 1 to September 15 for cool season crop.

3. Fertilization: Care should be taken to determine the needs for commercial fertilizers. Frequently the existing soil fertility is not sufficient to produce a satisfactory cover crop. Application of commercial fertilizer according to lab test is recommended where needed.

4. Acceptable Species and Rate of Seedings for Drilling:

a. Warm season	Rate (lbs./ac) Dryland
Grain sorghum (excluding dwarf varieties)	5-8#
Forage sorghum	8-12#
Sudan	10-15#
Millet	12-15#
Broomcorn	10-15#
b. Cool season	
Wheat	45-60#
Oats	45-60#
Barley	45-60#
Rye	45-60#
Speltz	45-60#
Triticale	45-60#

5. Management

a. Preparatory crops should not be permitted to make

seed. If seed crop is likely to be produced, mow or shred to a stubble height of six to ten inches.

b. The cover crop must be protected from grazing.

c. Adequacy of Prepared Cover

(1) The minimum amount of residue required is as follows:

Soil Texture	Type of Cover	Pounds Per Acre
Loamy Sand, lvfs, and lfs	drilled	1,200
Sandy loam, fsl, c, and sic	drilled	850
Loamy scl, sil, cl, and sicl	drilled	600

(2) Cover must be sufficiently dense throughout the area to protect it from wind erosion.

C. Clean-tilled

In areas where soil temperatures and wind erosion are not major factors, a clean tilled seedbed is acceptable. There is an advantage in having the seedbed firm but in a cloudy condition to shade and protect the new seedlings.

D. Seedbed Compaction

A suitable seedbed should be firm below the seed and loose above it. If a person's heel sinks in more than 3/4 of an inch, suitable packing should be done to firm the seedbed. Loose topsoil mulch generally gives the best conditions for moisture and seed placement.

E. Improving Moisture Conditions

In many areas associated rangeland treatment is needed to improve the inherent moisture conditions on a project site. These may include mulching, summer fallowing, establishing basins or pits, water spreading, or other similar measures. Mulch is the most common means of providing suitable surface litter to protect new seedings on critical sites, such as those from new construction. This is nothing more than a rapid method of substituting hay or other litter for a prepared cover crop.

In areas of limited precipitation it is highly desirable to limit vegetative growth on an area during the growing season before seeding. This allows a subsoil moisture buildup which will help in the establishment of a desirable stand. Summer fallowing should normally be limited to those areas where wind erosion is not a critical factor.

The establishment of basins or pits through the use of cut-away pitters, road maintainers or other equipment is desirable in most of the desertic part of the state. This helps concentrate moisture in a smaller area. The resulting seeding normally will establish only in the pitted areas. This condition does allow for a certain amount of early soil movement into the basins or pits. Pitting, counter-fallowing or similar measures may be required above an area to be seeded, to reduce the runoff across the treated area. This situation most commonly exists on extremely erosive soils such as the clays and clay loams derived from redbed materials and shale. One should not confuse pitting with a means of seedbed preparation. It normally should be used in conjunction with other acceptable seedbed preparation methods.

Water spreading across seeded areas increases the initial hazard of erosion until plants are established; however, the additional water usually increases stand establishment and later forage production.

VII. Seeding Methods

A. Drilling

Drilling is by far the superior method of seeding except where terrain or obstructions prevent use of a drill. Site and species determine the kind of drill that can best seed an area.

1. Equipment Considerations

The following are some of the desirable features included on some grass drills:

a. Double disc provides for opening a trench for seed in a manner that permits good seed coverage without excessive soil movement.

b. Proper depth control is provided by depth bands or depth plates. These prohibit the disc from sinking in beyond a given depth.

c. Proper seeding rate regulator to control the amount of seed to be planted.

d. Seed agitators mix seed in the drill box to maintain a proper blending of different size seed and to keep fluffy seeds from lodging in the drill box.

e. Separate boxes for large and small seed to provide for more uniform distribution of seed of different sizes.

f. Press wheels or drags to firm the seedbed. The most desirable condition is to have press wheels ahead of the disc, and packer wheels follow the seeding operation.

g. Proper seed feeds vary with the type of seeding being used. Picker or thimble feeds perform best on trashy grass or browse seeds like the bluestems.

2. Types of Drills

a. Rangeland Drill

This drill is a rugged seeder with high clearance designed to work on rough sites. It has performed well on rough seedbeds. It can be converted to a deep furrow implement by cupping the discs enough to make good furrows. The depth of the furrow is controlled by adding or taking off disc arm weights. Weights up to 70 pounds have been used under some conditions.

b. Oregon Press Drill

This implement was developed by the Agri-Engineering Department of Oregon State University. It was designed for seeding on plowed or loose seed beds. A heavy press wheel packs the soil. The seed is placed in the packed furrow and an adjustable drag covers the seed. This drill cannot be used on rocky or rough seed beds.

c. Plains Double Disc Drill

This machine is equipped with double disc, depth bands, covering device, press wheels, seed agitator

and adjustable feeding mechanism that handles trashy seed. The plains drill is not built strongly enough nor has it ample clearance to be used on many rough or brushy sites. Therefore, this drill is most suited to fairly level, non-stony sites which commonly exist in the plains and mountain parks.

d. Grain Drill

The drills in this group are designed and built for use on cultivated fields. They are too lightly constructed for seeding on rough seedbeds. Breakage is a problem, and the seed is often not placed properly in the ground. For these reasons, they should not be used for rangeland seedings if other drills can be obtained.

e. Range Interseeder

This drill is equipped with a furrow opener, double disc, depth bands, boxes for large and small seed, and press wheels. The furrow openers are designed to open a trench about 14 inches wide and 2 inches deep and spaced 34 to 42 inches between centers. The seed is planted in the flat bottom furrow.

Range interseeding may be used to introduce desirable plants into stands of less desirable perennial plants. It also offers a method of introducing browse species into existing vegetation.

To be successful, the seeded species must be of a higher successionary level than the vegetation into which it is being introduced. The seeding should not be done in annual vegetative cover. Movement of surface soil in this case will usually result in covering seed too deeply.

The use of aggressive vegetative reproducing species or good seeders should be practiced in range interseedings. Grazing management should be based on the needed species. With proper management the seeded rows will spread into associated vegetation.

Range interseeding is not a substitute for a complete seeding where full seedbed preparation can be done. It is primarily intended for use on sandy

sites where erosion hazards are too great to destroy existing vegetation or where a partial stand of desirable plants already exists.

Seeding rate should be one-half that of a common drill.

f. Browse Seeders

These implements operate similarly to the range interseeder in that small furrows are opened at wide intervals for seeding of browse. The furrows are about 4 inches wide, rather than 14. The seeding device is simpler than that of the interseeder. Its use is limited to the introduction of browse and forbs in established vegetation on non-stony sites.

3. Calibration of Seeding Equipment

There are several methods of calibrating drills for seeding a certain number of pounds per acre. The following two methods are simple and adequate.

a. Place a canvas on the ground and run drill over the canvas. Count the number of seeds per foot of drill row. Suppose one is seeding the following mixture:

Pubescent wheatgrass, 4 pounds per acre
Hard fescue, 2 pounds per acre

In this case the seed would be thoroughly mixed. From table 3 it is determined that pubescent at 4 pounds per acre should have 8 seeds per square foot or 1 foot of linear drill row. Hard fescue at 2 pounds per acre should have 26 seeds per linear drill row. A drill setting to have a combination of about 34 seeds per foot of drill row would be all right for the above example.

b. Jack up one side of drill. Fill hopper with desired mix and set feed regulator at the desired sowing rate. Place a canvas under the drill. Rotate wheel until the land measure registers the predetermined acreage on which to base your trial. Weigh seed, calculate poundage per acre and adjust feed rate accordingly. If the drill is not equipped with a land measure, determine the circumference of the wheel and number of rotations per acre. Then turn the wheel the

correct number of revolutions. Remember that you may be using only one-half of the drill. Adjust drill setting and repeat until desired poundage is obtained.

B. Broadcasting and Hydroseeding

Broadcasting of seed either by aerial or ground operation has been successful when competing vegetation has been eliminated either by fire or mechanical and chemical methods. Under some conditions it is necessary to use a method of covering the seed after it has been broadcast. Flexible harrows are well adapted to covering seed.

Small-seeded species lend themselves to broadcast seeding much better than large-seeded species. Small seeds are covered by natural slough. Under severe conditions, some type of mulch has been beneficial in connection with broadcast seeding.

1. Limitations

Limitations to broadcast seeding are: it requires a heavier seeding rate; covering of seed is poor compared to drilling; distribution is often poor; loss of seed to rodents and insects can be great; and establishment is generally slower.

2. Seed Application and Distribution

a. Aerial Application

Aircraft must be equipped with a positive power driven seed metering device. An adjustable opening which allows the seed to drop out of the hopper by gravity is not acceptable when a mixture of various seed sizes and weights is being seeded.

The following is a list of points which must be taken into consideration when planning and accomplishing seeding with aircraft.

(1) Planning Seed Needs. To determine the amount of seed needed for the total project, use gross acreage. It is cheaper to seed gross area than it is to try to avoid islands and other areas not desired for seeding.

If the terrain is rough and the area has uneven edges, figure seed needs on gross acres plus 10%.

(2) Preparation Prior to Aerial Seeding

(a) Mix seed prior to scheduled aerial application.

(b) Weigh and mark weight on each sack of mixed seed. Each sack should not weigh over 50 pounds. Weights are used to pregroup each load prior to actual loading operations and also to keep an estimate of seed being applied per acre.

(c) Arrange for pilot to fly a reconnaissance to acquaint himself with area and feel out terrain and air conditions.

(d) Locate helispots so that seeding can be accomplished with minimum of ferry time. Generally one helispot per 1000 acres is sufficient. However, this will vary with layout of area to be seeded.

(e) Keep seed dry. If there is a chance of rain, do not leave seed in field overnight; or provide for covering with rainproof material.

(3) Procedure During Seeding Operation

(a) Calibrate seeding rate. Place cardboard cards, 1-foot square, perpendicular to line of flight about 10 feet apart. Cover the cards with a light grease. Seed will stick to the greased cards. The number of seeds on each card can be counted and applied back to the desired number of seeds per square foot. The greased cards will also help determine the distribution of seed and the effective swath width.

In addition, a further determination for calibration can be made by establishing a check area of a given acreage. Let the

pilot fly until he has covered about half the known acreage. Check the hoppers and adjust accordingly. This may have to be repeated a couple of times.

(b) Make first seeding pass around exterior boundaries of area. This will assure seed coverage for the edges and facilitate turn-around efforts for the helicopter.

(c) Fly grids against or with wind. Do not fly cross wind unless absolutely necessary.

When flying with or against wind, flight time per day can be extended considerably.

(d) Flights should start as early as possible--just as soon as there is light enough for pilot to see for safe flight. Normally this is the quiet time of day.

(e) Winds will dictate the duration of operation in any one day. Do not seed in winds in excess of 15 miles per day.

(f) Keep track of pounds of seed and acreage covered as a check on distribution of seed and calibration of helicopter.

(g) Keep strings, seed tags, and other foreign material out of seed hopper. Paper seed sacks are recommended.

b. Broadcasting Ground Application

Ground broadcasters are primarily of three types:

(1) Rotary Spreaders. In this type, the seed falls from a hopper onto a rotating ribbed disc which distributes the seed by centrifugal force. The width of throw depends on size and weight of seed, speed of rotating disc and velocity of wind. Rotary spreaders may be carried by hand or mounted on or trailed behind a tractor or seedbed preparation unit. They are generally powered by hand, gasoline, electric motor or power take-off. Limitations of this type of seeder are:

(a) Swath width and rate of seeding vary with speed of travel and speed of rotating disc. In most of these machines, there is no control over speed of the drive motor.

(b) Seed is not spread as evenly as from a drill box. The amount of seed is greatest near the center of the swath.

(c) Where seed mixtures are used, sifting of seed by weight occurs because an agitator is not used.

(2) Seeder Boxes of the Drill-like or Fertilizer-Spreader Type: In this type, a fluted or force gear feed mechanism lets seed fall out of the bottom of the box onto the ground. The seed box is mounted on equipment such as brushland plows or brush choppers.

In general, the seeder box type of broadcaster distributes seed more uniformly than does the rotary type. A recent adaptation of this type of broadcaster is the "seed dribbler". The dribbler was designed to be mounted on the right and left side of the deck of a track tractor. The seed drop mechanish has a direct drive from a rubber tired wheel riding on the tracks of the tractor and utilizes a fluted forced feed. The seed is metered onto the track pad just as it breaks over the front idler. It drops off the pad in front of the track and is embedded in the soil as the tracks pass over. The seed box units of the browse seeder can also be adapted for use as "dribblers".

(3) Broadcast Units Using an Air Stream to Dispense Seed: The seed is metered from a hopper either by gravity or positive feed into an air stream. The air stream can be created either by exhaust from equipment motors or by a fan designed for this purpose. Seed distribution is poor when seeding is done on days when wind velocities are high. Swath width is unpredictable depending on weather conditions.

(4) Hydroseeding: Hydromulchers are often used to apply seed and mulch to disturbed areas such as road cut and fill slopes. This machine applies seed by means of a high pressure stream of water. Seeding success can be increased by applying the seed in one operation followed by an application of mulch. Hydroseeding generally violates several of the basic principles of seeding. Many of the slopes which are hydroseeded are too steep for seed retention and stabilization. Proper slope design and attention to basic seeding principles will improve seeding success considerably.

c. Covering Seed

An efficient and economical method of covering seed following broadcasting on large projects is by chaining. There are additional benefits for pinyon-juniper areas that have been burned. The mixing of the ashes with mineral soil helps prevent crusting and further reduces debris to give the landscape a more pleasing appearance.

The following points should be considered in this type of operation.

(1) Chaining should start immediately after seeding.

(2) Within limits, the heavier the chain, the better the overall results. This may vary with the debris on and soils at the site.

Double chaining with a lighter chain will give more complete coverage of seed and not bury some seed as deeply as a single heavy chain.

(3) All chaining should be accomplished on the contour.

(4) In areas where residual vegetation such as blue grama is dense, double chaining to break up the sod is necessary. Properly accomplished, chaining provides a method of interseeding into low producing blue grama stands.

(5) Chaining should not be done if the soil is too wet so that it puddles.

VIII. Treatment of Critical Areas and Burns

The surface of the soil is torn up on extensive areas each year in connection with construction work to develop recreation areas, stock tank and other water impoundments, utility rights-of-way, and similar projects. It is desirable to stabilize and rehabilitate, at the earliest time, all disturbed areas. Guidance for this is included in Committee Reports 7 and 7A on critical area stabilization. Report 7A is no longer available.

A. Road Cut and Fill Slopes and Similar Sites

On these areas where erosion control is the primary purpose of the planting, species should be used which will give a fast, dense cover. In addition, they should have a large, strong fibrous root system that will bind and hold the soil. Grass is the plant which comes closest to having these desirable characteristics. Shrubs are slow developing, leaving areas bare for a considerable period of time. Flowering shrubs may be used for landscaping in conjunction with grass for erosion control.

Highly palatable plants are not recommended where there are other alternatives in seed mixtures for cut and fill slopes, because of their high attraction to livestock and wildlife, and thus the resulting safety hazard.

1. Seedbed Preparation

a. On new construction to be seeded immediately, leave cut slopes with 4 to 6 inches of loose soil. The surface should appear similar to a disked field. Road design specifications should provide for this scarification on earth cut slopes.

b. On old construction, scarify the surface 4 to 6 inches deep. Rip, disc and harrow on the contour or parallel to the road wherever possible. On steeper slopes, it may be necessary to work equipment at an angle or with a lead cable from above and/or below the slope.

c. On cut slopes 1½ : 1 or steeper, use a hydroseeder or prepared mulch, or stake mulch in place.

d. When the surface of a slope is more than 70% rock, no revegetation is recommended except for aesthetic values.

2. Seeding Methods

a. Drill seed wherever possible in prepared seedbed. Drilling will be done on the contour or parallel to the roadbed, when possible.

b. Where drilling is impractical, broadcast seed on roughed-up seedbed. Harrow the area to cover the seed.

c. On steep slopes, 1½ : 1 or greater, seed with a hydromulcher, or broadcast seed and cover with prepared mulch strips.

3. Seeding Time

On newly constructed projects, seed as soon as practical after bank is finished. On old construction, time seedbed preparation and seeding to take advantage of rainfall pattern of local area.

4. Mulching

Mulching is needed on steep slopes where it is difficult to keep seed in place or where excessive soil drying will take place. Common methods of mulching are:

a. Hydromulching

Wood or other fibers are applied by a hydromulcher as described in the section on seed application.

b. Asphalt Mulching

c. Spread grass, hay or aspen excelsior, followed with disking to anchor the hay or excelsior. A special anchoring disc should be used.

d. Hand mulching with a prepared mulch such as excelsior mats. In this method the rolls of mulch are staked in place. Place mulch strips vertical to slope. Prepared mulch rolls are expensive and should be used only on special treatment areas.

Mulch applied at rates of over 3 tons per acre can be harmful. When the mulch is too thick, the small seedlings cannot break through. Mulch is not a substitute for fertilizer, which is necessary on the raw soils of construction sites.

B. Burns

A need generally exists for seeding burns to reduce erosion, improve wildlife habitat, and to provide useful vegetation instead of annuals and undesirable native vegetation which comes in after disturbance or fire. Erosion is usually controlled best by a combination of mechanical and vegetative means. Mechanical control is based on effective drainage and dispersion of surface runoff. Seeding supplements this by providing protective cover, thereby reducing the amount and effect of runoff.

The most common method of seeding is broadcasting. For large acreages, aerial application is the most efficient method. Helicopters are recommended because more accuracy and even distribution of seed is possible than with fixed-wing planes.

Seed areas immediately following disturbance or fire, regardless of season.

It is most important to get the seed on the ground before crusting of the ashes or soil surface.

IX. Fertilization

Fertilization of native perennial range types for increased production has limited application in the Southwest. The response to fertilizer is related to soil type and moisture availability. Most dryland sites are deficient in both. The exception is wet meadow situations with good soil and adequate moisture. Fertilizer applications have given increased yields of forage under these conditions.

A. Fertilizer as an Aid to Seeding Establishment

Fertilizer can effectively be used in the establishment of seeded species at time of seeding. The fertilizer must be placed near the drill row for maximum benefits. More efficient use is made of the fertilizer and much lower rates of application can be used than in broadcast applications. The latter method stimulates competing vegetation to the detriment of the seeded species.

It is very important to use fertilizer in establishing vegetation on critical areas. Pelleted forms of fertilizer should be used when applied at time of seeding; otherwise, the plant food is lost before the seedlings emerge.

B. Maintenance of Vegetation on Cut Slopes

Any artificially established vegetation on semi-sterile cut slopes must at times receive a maintenance application of fertilizer to avoid degradation of the vegetation.

C. Soil Testing

Soil tests provide a scientific basis for determining the available nutrients in the soil. Recommendations for amounts and kinds of fertilizers are based on soil test results. Soils should be tested to determine the nutrient deficiencies.

D. Facts about Fertilizers

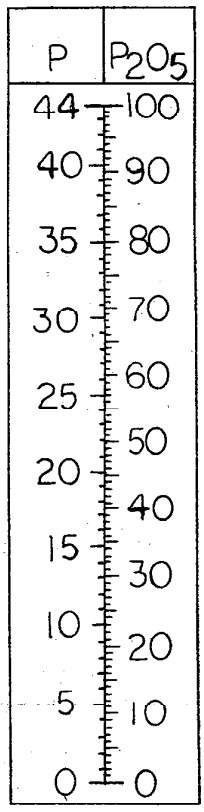
To know what you are buying, look on the bag for the guaranteed analysis. It is shown as 10-10-10 or 16-20-0, or other numbers which vary with analysis. The first figure states the percentage of elemental nitrogen (N), the second figure shows the percentage of phosphorus expressed in available P_2O_5 (phosphoric acid), and the third figure shows the percentage of potassium expressed as soluble K_2O (soluble potash). In recent years an effort has been made to get phosphorus and potassium content of fertilizers labeled in the elemental form P and K rather than P_2O_5 and K_2O. Oxygen (O) accounts for more than half the weight of P_2O_5 (56%). Oxygen accounts for 17% of K_2O.

Soil test reports express plant nutrients needed in the elemental form. Therefore, fertilizer nutrient should be figured on the same basis.

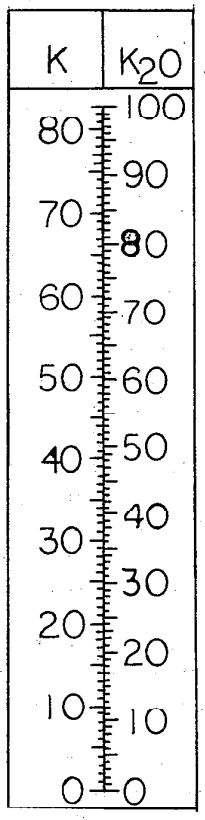
Commercial fertilizers generally contain nitrogen (N) in one of two forms, nitrate or ammonia. In the nitrate form, nitrogen is readily available to plants. This form should be applied during the growing season. The ammonia form must break down before nitrogen becomes available for plant use. This form should be used with fall seedings or slow establishing plants.

Scales for converting elemental and oxide forms of phosphorus and potassium follow:

Phosphorus Scale



Potassium Scale



The conversion scale simplifies the job of exchanging oxide for elemental values. The scales convert the elemental P and K to the oxide P_2O_5 and K_2O form or vice versa, in either percent or pounds. Assume the phosphorus (P) recommendation in a soil test report is 30 pounds per acre. Locating 30 under the P scale and reading across the line, the equivalent amount of P_2O_5 would be about 69 pounds per acre.

X. Management

A. Protection from Grazing

All newly seeded areas should be protected continuously from all grazing by domestic livestock to the end of the second growing season from date of seeding, or longer if needed to establish the grass. Livestock grazing thereafter should not exceed proper use and be managed under a grazing system. See Committee Report No. 5, "Grazing Management Systems in New Mexico".

B. Weed Control

The new grass must be kept reasonably free of weeds. Weed control measures may be applied by mowing, shredding, or by use of chemical sprays if necessary during the first growing season following seeding. Chemical control of broad leafed annual weeds may be done by applying a spray containing approximately 1/2 to 3/4 pound of 2, 4-D, or 2,4,5-T low volatile ester after the grass seedlings have reached the third leaf stage. For persistent weeds, (field bindweed) use several cultivations with sub-surface tillage implement before seeding, and a follow-up chemical spray of 2, 4-D amine two weeks before frost. Chemical spraying must be avoided if a legume or forb has been used in the seeding mixture.

Individuals using chemical herbicides must be cautioned about improper handling of herbicides and the safe disposal of unused portions to avoid injury to humans, domestic animals, desirable plants, and fish or other wildlife, and any contamination of nearby crops. They should follow the directions and heed all precautions on the container label. Herbicides should not be used over or directly adjacent to irrigation ditches, ponds, lakes, streams or homes.

Federal, state and county laws and regulations governing the use of herbicides must be adhered to. This will be the responsibility of the manager and applicator. Before using any chemical, a person should check to make certain the one being considered is registered for the planned purpose.

The control chemical 2,4,5-T must be used in such a way that no residue will pass on in crops or meat animals.

C. Rodent and/or Insect Control

If rodents or insects become so numerous that they are causing excessive damage to seeded grass, control measures

should be taken promptly. Guidance on insect control may be secured from the Animal, Plant, Health Inspection Service. Recommendations on rodent control are available from the U. S. Fish and Wildlife Service.

D. Stand Evaluation

Grasses are slow to establish in the arid Southwest. Therefore, new seedings should not be considered failures without allowing ample time and moisture to develop. This is usually 2-4 years, depending on the site.

Research Needs

1. To obtain basic information on the physiological and ecological factors limiting growth and persistence of range plants.

2. Evaluate range sites with respect to climate, soil and overall value to society, as indicators of potential for successful seeding.

3. Evaluate seedbed preparation and seeding techniques, including season, rate and depth of seeding.

4. Study microclimatic relationships with respect to germination, root elongation and seedling establishment.

5. Breeding research to improve seed quality, germination, seedling vigor, and disease and drought resistance of seedlings.

6. Develop or identify species suitable for seeding that have special merit for erosion control, longevity, drought resistance, salt tolerance, grazing tolerance, nutritional value, and palatability for game and livestock.

7. Determine the value of preplanting seed treatments.

8. Design and develop equipment that will provide for adequate soil compaction, precision placement of seed, and improved soil water retention.

9. Determine damage by rabbits, rodents, insects and disease on seedlings. Develop control methods for problem organisms.

10. Develop control methods for undesirable plants competing with seedlings.

11. Improve the efficiency of seed production and assure reliable supplies of high quality seed of improved varieties.

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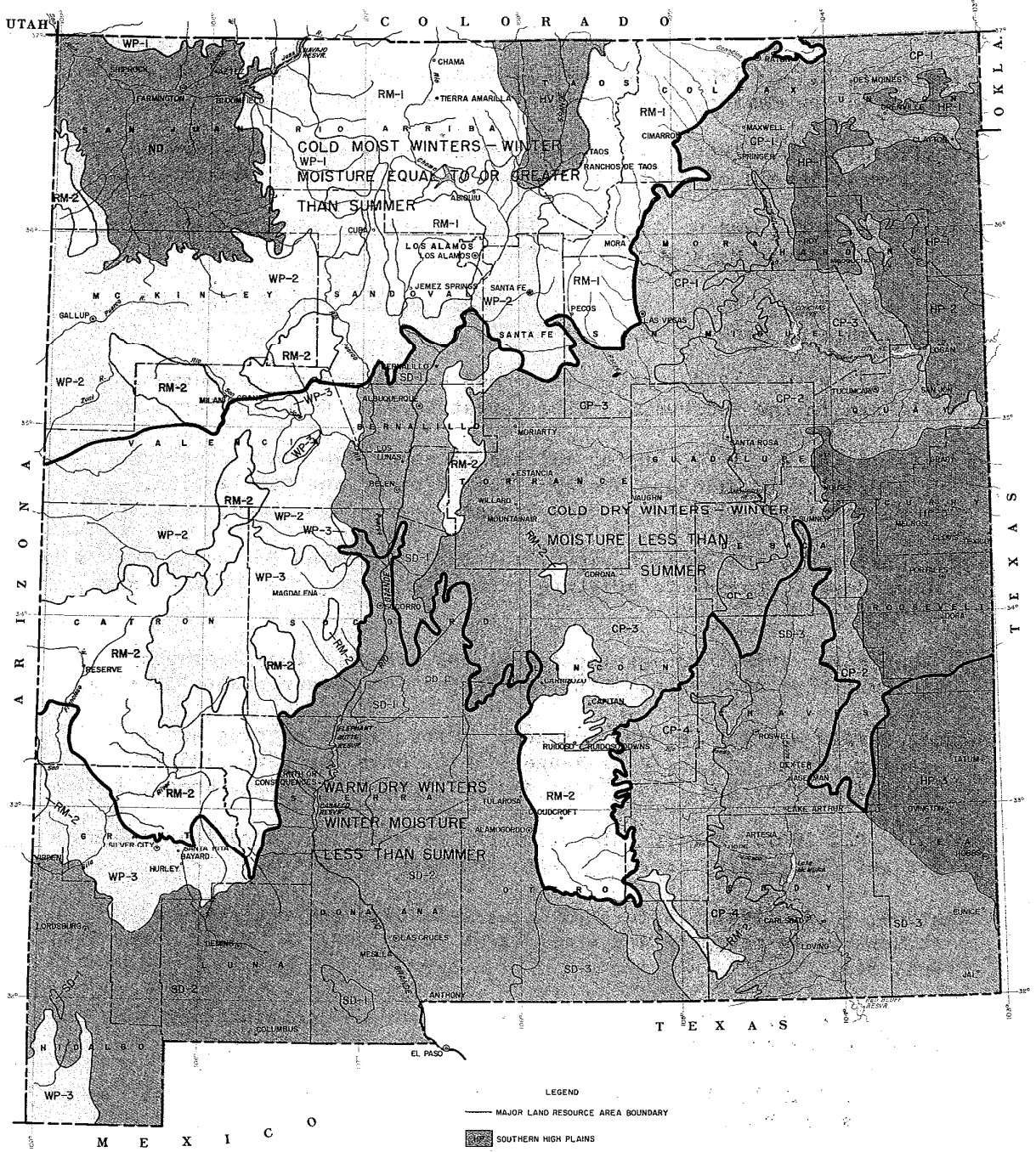
Figure I



MAJOR LAND RESOURCE AREAS
NEW MEXICO
FEBRUARY 1973
10 0 10 20 30 MILES
SCALE 1:3,500,000

[1]USGS National Atlas 1:1,000,000 Albers Equal-Area projection (1967) used as source for base map and adapted for SCS use.

GPO 16-PORTLAND, OREGON-1973

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Figure 2

SEEDING DATES
FOR SPECIES COMMONLY USED IN NEW MEXICO

Dates of seeding will correspond to the high probability (60% or more) of receiving effective precipitation (.6 to 1.0 inch during any three week period) for seedling establishment, and 45 days before extended dry periods and average frost dates.

Resource Area	Warm Season Species	Cool Season Species
HP-1,2,3	June 15 to August 1	May 1 to August 1
CP-1,2,3	June 15 to August 1	June 1 to August 1
CP-4	July 15 to August 15	June 15 to August 15
WP-1,2 2/	July 15 to August 15	July 15 to August 15
WP-3	June 15 to August 15	June 15 to August 15
HIV	June 1 to July 15	June 1 to July 15
RM-1	June 1 to July 15	June 1 to July 15
RM-2	June 15 to July 15	June 1 to July 15
ND- 1/	July 15 to August 15	July 15 to August 15
SD-1,2,3 1/	June 15 to August 1	June 15 to August 1

See "Probability of Selected Precipitation Amounts" section for New Mexico, Report T-8, Agricultural Experiment Station, University of Nevada.

If local conditions justify, the dates of planting may be adjusted.

1/ Seeding on ND and SD-1, 2 and 3 is not recommended unless special equipment is used to modify the microenvironment.

2/ October is a suitable time for seeding cool season species in WP-1 if germination does not take place before frost.

Figure 3

SEED CHARACTERISTICS AND SEEDING RATES
FOR SPECIES COMMONLY USED IN NEW MEXICO

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq. Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species * Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Alfalfa Medicago sativa	Latak Nomad Rambler	225,000	99	85	5.2	4.0	8.0	12.0
**Alkali sacaton Sporobolus airoides		1,750,000	98	80	40.0	0.5	1.0	1.5
**Antelope bitterbrush Purshia tridentata		20,000	80	80	0.5	40.0	80.0	--
Apache plume Fallugia paradoxa						3.0	5.0	9.0
**Arizona fescue Festuca arizonica		550,000	90	75	12.8	2.0	3.0	5.0
Bermuda grass Cynodon dactylon	Midland	1,580,000	97	86	36.3	.5	1.0	1.5
Big bluegrass Poa ampla	Sherman	917,000	90	70	21.0	1.0	2.0	3.0
Big bluestem Andropogon gerardii	Kaw	191,000	90	82	4.4	7.0	9.0	14.0

* Figures rounded to ½ pound units
** Seed is usually in short supply or not available

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Recommended Lbs/Acre Single Species * Seeds per Sq. Ft. at 1 Lb./A.	Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Big trefoil Lotus uliginosus	Marshfield	828,000			23.0	1.0	1.5	2.0
Birdsfoot trefoil Lotus corniculatus	Granger Cascade	418,000	98	47	9.6	3.0	4.5	6.0
**Black grama Bouteloua eriopoda	Nogal	1,335,000	40	60	31.0	1.0	1.5	2.0
**Black medic Medicago lupulina		800,000	95	85	18.0	1.5	2.0	--
Blue grama Bouteloua gracilis	Lovington	712,000	40	60	16.5	1.5	2.5	3.5
Blue panicgrass Panicum antidotale		679,000	70	60	16.0	1.5	3.0	4.0
**Blue wildrye Elymus glaucus		131,000	80	85	3.1	8.0	12.0	19.0
Boer lovegrass Eragrostis chloromelas	Catalina	2,922,000	90	70	69.0	0.5	0.5	1.0
Buffalo grass (burr) 1/ Buchloe dactyloides		42,000	88	45	1.0	10.0	--	--

1/ Recommended seeding rate is ½ that shown for other species. Buffalo grass should not be broadcast.

* Figures rounded to ½ pound units

** Seed is usually in short supply or not available.

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq. Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species * Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Burnet Sanguisorba minor		53,000	90	80	1.2	16.0	34.0	--
**Bush muhly Muhlenbergia porteri		1,500,000	50	40	38.0	1.0	1.0	1.5
Cicer milkvetch Astragalus cicer	Lutana	122,000	90	15-50 1/	2.8	8.0	13.0	22.0
Crested wheatgrass Agropyron desertorum	Nordan	200,000	95	85	4.6	5.0	8.0	13.0
Fourwing saltbush Atriplex canescens		30,000	80	50	1.1	18.0	36.0	--
Galleta Hilaria jamesii		159,000	69	80	3.7	6.0	11.0	16.0
Hard fescue Festuca ovina var. duriuscula	Durar	565,000	95	85	13.0	2.0	3.0	5.0
Harding grass Phalaris tuberosa		547,000	95	80	8.1	3.0	5.0	7.0
Havard panic Panicum havardii						8.0	16.0	24.0

1/ With proper scarification

* Figures rounded to ½ pound units
** Seed is usually in short supply or not available

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq.Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species* Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Indiangrass Sorghastrum nutans	Llano	175,000	89	53	4.0	6.0	10.0	15.0
**Indian ricegrass Oryzopsis hymenoides		235,000	95	11	5.4	4.0	7.0	11.0
Intermediate wheatgrass Agropyron intermedium	Amur	100,000	90	85	2.4	10.0	17.0	24.0
Kentucky bluegrass Poa pratensis		2,156,000	90	75	50.0	0.5	1.0	1.0
Lehmann lovegrass Eragrostis lehmanniana		4,245,000	90	60	99.0	0.5	0.5	0.5
Little bluestem Andropogon scoparius	Pastura	379,000			8.7	4.0	7.0	11.0
Meadow brome Bromus biebersteinii	Regar	100,000	92	85	2.4	10.0	17.0	24.0
Meadow foxtail Alopecurus pratensis	Garrison	900,000	80	80	21.0	1.0	2.0	3.0
**Mountain brome Bromus marginatus		90,000	90	85	1.6	16.0	25.0	38.0

* Figures rounded to ½ pound units
** Seed is usually in short supply or not available

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq. Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species* Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
**Mountain mahogany Cercocarpus montanus		40,000	80	40	0.9	21.0	42.0	--
Orchardgrass Dactylis glomerata	Potomac Latar	540,000	90	80	12.0	2.0	4.0	5.0
Perennial ryegrass Lolium perenne		247,000	98	90	5.7	4.0	7.0	10.0
**Plains bristlegrass Setaria macrostachya		293,000			7.0	3.0	5.0	8.5
Pubescent wheatgrass Agropyron trichophorum	Luna	91,000	90	85	2.0	12.0	20.0	30.0
Reed canarygrass Phalaris arundinacea	Ioreed	550,000	98	64	12.8	2.0	3.0	5.0
Rocky Mountain penstemon Penstemon strictus		280,000	93	79	6.42	3.0	6.0	10.0
**Rubber rabbitbrush Chrysothamnus nauseosus						1.0	2.0	3.0
Russian wildrye Elymus junceus	Vinall	170,000	90	80	3.9	6.0	10.0	15.0
Sainfoin Onobrychis viciaefolia		18,000	97	80	.41	49.0	98.0	146.0

* Figures rounded to ½ pound units
** Seed is usually in short supply or not available

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq.Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species * Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Sand bluestem Andropogon hallii	Elida	125,000	70	69	2.9	8.0	14.0	21.0
Sand dropseed Sporobolus cryptandrus		5,298,000	90	70	123.0	0.5	0.5	0.5
Sand lovegrass Eragrostis trichodes	Bend	1,550,000	93	75	35.6	1.0	1.5	2.0
Siberian wheatgrass Agropyron sibericum	P-27	250,000	95	85	5.7	4.0	7.0	10.0
Sideoats grama Bouteloua curtipendula	Vaughn El Reno	143,000	60	50	3.3	7.0	12.0	18.0
Slender wheatgrass Agropyron trachycaulum	Primar	160,000	90	85	3.7	7.0	12.0	17.0
Smooth brome Bromus inermis	Lincoln Manchar	125,000	92	85	2.9	8.0	12.0	19.0
Spike muhly Muhlenbergia wrightii		1,635,000	50	50	38.0	1.0	1.0	1.5
**Strawberry clover Trifolium fragiferum		323,000	98	53	7.4	3.5	5.5	8.0
Streambank wheatgrass Agropyron riparium	Sodar	170,000	97	92	3.6	7.0	11.0	17.0

* Figures rounded to ½ pound units

** Seed is usually in short supply or not available.

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Seeds per Sq.Ft. at 1 Lb./A.	Recommended Lbs/Acre Single Species * Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Sweetclover Melilotus sp.		262,000	99	85	6.0	4.0	7.0	10.0
Switchgrass Panicum virgatum	Blackwell	278,000	95	62	6.4	4.0	6.0	10.0
Tall fescue Festuca arundinacea	Alta	242,000	96	86	5.5	4.0	7.0	11.0
**Tall oatgrass Arrhenatherum elatius	Tualatin	150,000	84	79	3.4	7.0	12.0	17.0
Tall wheatgrass Agropyron elongatum	Jose	79,000	95	85	1.8	12.0	22.0	32.0
Thickspike wheatgrass Agropyron dasystachyum	Critana	186,000	95	91	4.3	5.0	10.0	14.0
Timothy Phleum pratense	Climax	1,300,000	97	80	30.0	1.0	1.5	2.0
**Tobosa Hilaria mutica		204,000	8	42	4.7	5.0	9.0	13.0
**Vine mesquite Panicum obtusum		143,000	50	30	3.3	7.0	12.0	18.0

* Figures rounded to ½ pound units

** Seed is usually in short supply or not available

Figure 3
(Cont.)

Name	Recommended Variety	Seeds per Lb.	Average Purity	Seed Quality Germination	Recommended Lbs/Acre Single Species* Seeds per Sq. Ft.at 1 Lb./A.	Drilling 20-25 Seeds per Sq.Ft.	Broadcast 40 Seeds per Sq.Ft.	Broadcast Critical Areas-60 Seeds per Sq. Ft.
Weeping lovegrass Eragrostis curvula		1,463,000	90	90	34.0	0.5	1.0	1.5
Western wheatgrass Agropyron smithii	Barton Rosana	110,000	85	60	2.5	10.0	17.0	24.0
White clover Trifolium repens		800,000	99	85	18.0	1.5	2.0	4.0
Wilman lovegrass Eragrostis superba	Palar	1,103,000	95	52	25.3	1.0	1.5	2.5
**Winterfat Eurotia lanata		150,000	52	80	3.3	6.0	12.0	--
**Yellow bluestem Bothriochloa ischaemum		~~1,409,000~~ 475,008 KRS Wendell Oakes 4/25/79	60	70	~~32.0~~	~~1.0~~	~~1.5~~	~~2.0~~

* Figures rounded to ½ pound units
** Seed is usually in short supply or not available

Figure 4

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Moist Winters

(Legend for Vegetative Zones is on Last Page of Table)

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No. RM-2	WP-1	No. WP-2	ND	HIV
Cool Season Grasses											
Big bluegrass Poa ampla		x				P,PJ	P,PJ				
Blue wildrye Elymus glaucus	x	x			x	MC,P	MC,P				
Crested wheatgrass Agropyron desertorum		x				S,PJ	S,PJ	x	x	x	x
Hard fescue Festuca ovina var. duriuscula		x	x			P,PJ,S	P,PJ,S				
Indian ricegrass Oryzopsis hymenoides	x	x				PJ,S	PJ,SR	x	x	x	x
Intermediate wheatgrass Agropyron intermedium		x				P,MC	P,MC				
Meadow brome Bromus biebersteinii		x			x	P,MC	P,MC				
Meadow foxtail Alopecurus pratensis	x	x	x	x	x	MC,P,PJ	MC,P,PJ	1/	1/	1/	1/
Mountain brome Bromus marginatus		x			x	P,MC	P,MC				

Figure 4
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Moist Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No.RM-2	WP-1	No. WP-2	ND	HIV
Cool Season Grasses (Cont.)											
Orchardgrass Dactylis glomerata	x	x			x	MC,P	MC,P	1/	1/	1/	1/
Perennial ryegrass Lolium perenne	x	x			x	MC,P	MC,P				
Pubescent wheatgrass Agropyron trichophorum		x	x	x		PJ,P	PJ,P, SR	x	x		
Reed canarygrass Phalaris arundinacea	x	x			x	MC,P, PJ	MC,P, PJ				
Russian wildrye Elymus junceus		x				S	S,SR	x		x	x
Siberian wheatgrass Agropyron sibericum		x				S, PJ	S,PJ, SR	x	x		x
Slender wheatgrass Agropyron trachycaulum	x	x				PJ,P, MC	PJ,P, MC				
Smooth brome Bromus inermis	x	x			x	MC,P	MC,P	1/	1/	1/	1/
Streambank wheatgrass Agropyron riparium	x	x	x	x		S,PJ, P	S, PJ, P	x	x	x	x
Tall fescue Festuca arundinacea		x	x	x	x	MC,P	MC,P	1/	1/	1/	1/

Figure 4
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE
Cold - Moist Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No. RM-2	WP-1	No. WP-2	ND	HIV
Cool Season Grasses (Cont.)											
Tall oatgrass Arrhenatherum elatius		x			x	MC,P	MC, P				
Tall wheatgrass Agropyron elongatum		x	x	x	x	MC,P	MC, P	1/	1/	1/	1/
Thickspike wheatgrass Agropyron dasystachum	x	x				S,PJ	S,PJ,SR	x	x	x	x
Timothy Phleum pratense		x			x	MC,P	MC,P				
Western wheatgrass Agropyron smithii		x	x	x	x	S,PJ,P	S,PJ,P	x	x	x	x
Warm Season Grasses											
Alkali sacaton Sporobolus airoides		x	x	x	x	S,PJ	S,PJ,SR	x	x	x	x
Arizona fescue Festuca arizonica		x				MC,P	MC,P				
Big bluestem Andropogon gerardii	x	x			x	MC,P	MC,P				
Blue grama Bouteloua gracilis	x	x		x		S,PJ	S,PJ,SR	x	x	x	x

Figure 4
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Moist Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No. RM-2	WP-1	No. WP-2	ND	HIV
Warm Season Grasses (Cont.)											
Galleta Hilaria jamesii	x	x	x	x		S,PJ	S,SR	x	x	x	x
Indiangrass Sorghastrum nutans	x	x			x	MC,P	MC,P	1/	1/	1/	1/
Little bluestem Andropogon scoparius	x	x				P,PJ	P,PJ				
Sand bluestem Andropogon hallii	x					P	P				
Sand dropseed Sporobolus cryptandrus	x	x				S	S	x	x	x	x
Sideoats grama Bouteloua curtipendula	x	x				PJ,P	PJ,P	x	x		
Spike muhly Muhlenbergia wrightii	x	x				PJ	PJ	x	x		
Switchgrass Panicum virgatum	x	x			x	MC,P	MC,P	1/	1/	1/	1/

Figure 4
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Moist Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No. RM-2	WP-1	No. WP-2	ND	HIV
Forbs											
Alfalfa Medicago sativa	x	x				MC,P	MC,P				
Big trefoil Lotus uliginosus	x	x				MC,P	MC,P				
Birdsfoot trefoil Lotus corniculatus	x	x			x	MC,P	MC,P				
Black medic Medicago lupulina	x	x			x	MC,P	MC,P				
Burnet Sanguisorba minor	x	x				MC,P	MC,P				
Cicer milkvetch Astragalus cicer	x	x			x	MC,P	MC,P	1/	1/	1/	1/
Rocky Mountain penstemon Penstemon strictus	x	x				MC,P, PJ	MC,P PJ				
Sainfoin Onobrychis viciaefolia		x				MC,P	MC,P				
Strawberry clover Trifolium fragiferum	x	x			x	MC,P	MC,P				
Sweetclover Melilotus sp.	x	x			x	MC,P, PJ	MC,P, PJ				

Figure 4
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Moist Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	RM-1	No. RM-2	WP-1	No. WP-2	ND	HIV
Forbs (Cont.)											
White clover Trifolium repens	x	x			x	MC,P	MC,P	1/	1/	1/	1/
Shrubs											
Antelope bitterbrush Purshia tridentata	x	x				P,PJ	P,PJ	x	x		
Apache plume Fallugia paradoxa	x	x			x	P,PJ,S	P,PJ,S	x	x	x	x
Fourwing saltbush Atriplex canescens	x	x	x	x	x	S,PJ	S,SR, PJ	x	x	x	x
Mountain mahogany Cercocarpus montanus	x	x				P,PJ	P,PJ				
Rubber rabbitbrush Chrysothamnus nauseosus	x	x	x	x	x	PJ,S	PJ,S, SR	x	x	x	x
Winterfat Eurotia lanata	x	x				PJ,S	PJ,S, SR	x	x	x	x

Legend for Vegetative Zones within RM-1 and RM-2:
S = Sagebrush
SR = Snakeweed-Rabbitbrush
P = Ponderosa pine
PJ = Pinyon-juniper
MC = Mixed conifer
1/ = Wet sites only

Figure 5

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Dry Winters

(Legend for Vegetative Zones is on Last Page of Table)

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No.HP-3	So.WP-2	No.WP-3	RM-2
Cool Season Grasses														
Blue wildrye Elymus glaucus	x	x			x									MC,P
Hard fescue Festuca ovina var.duriuscula		x	x											P
Indian ricegrass Oryzopsis hymenoides	x	x										x	x	SR,PJ
Intermediate wheatgrass Agropyron intermedium		x												MC,P
Meadow brome Bromus biebersteinii		x			x									MC,P
Meadow foxtail Alopecurus pratensis	x	x	x	x	x									P,MC
Mountain brome Bromus marginatus		x			x									MC,P
Orchardgrass Dactylis glomerata	x	x			x									MC,P
Perennial ryegrass Lolium perenne	x	x			x									MC,P
Pubescent wheatgrass Agropyron trichophorum		x	x	x										P,SR

Figure 5
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Cold - Dry Winters

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No.HP-3	So.WP-2	No.WP-3	RM-2
Cool Season Grasses (Cont.)														
Reed canarygrass Phalaris arundinacea	x	x			x	1/	1/	1/	1/	1/	1/	1/	1/	MC,P
Russian wildrye Elymus junceus		x												P,PJ
Siberian wheatgrass Agropyron sibericum		x												P
Smooth brome Bromus inermis	x	x			x									MC,P
Streambank wheatgrass Agropyron riparium	x	x	x	x										PJ,MC,P
Tall fescue Festuca arundinacea		x	x	x	x									MC
Tall oatgrass Arrhenatherum elatius		x			x									MC
Tall wheatgrass Agropyron elongatum		x	x	x	x	1/	1/	1/	1/	1/	1/	1/	1/	MC
Thickspike wheatgrass Agropyron dasystachyum	x	x				x		x	x		x	x	x	P,SR

Figure 5
(Cont.)
SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Cold - Dry Winters

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No. HP-3	S. WP-2	No. WP-3	RM-2
Cool Season Grasses (Cont.)														
Timothy Phleum pratense		x			x									MC
Western wheatgrass Agropyron smithii		x	x	x	x	x		x	x		x			PJ, SR, P
Warm Season Grasses														
Alkali sacaton Sporobolus airoides		x	x	x	x	x	x	x	x	x	x	x	x	SR, PJ
Arizona fescue Festuca arizonica		x												P, MC
Bermuda grass Cynodon dactylon		x	x	x	x		x			x		x	x	
Big bluestem Andropogon gerardii	x	x			x	x		x	x		x			P, MC
Black grama Bouteloua eriopoda	x	x					x			x	x	x	x	
Blue grama Bouteloua gracilis	x	x		x		x	x	x	x	x	x	x	x	SR, PJ, P
Galleta Hilaria jamesii	x	x	x	x		x	x	x	x	x	x	x	x	SR, PJ

Figure 5
(Cont.)
SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Cold - Dry Winters

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No.HP-3	So.WP-2	No.WP-3	RM-2
Warm Season Grasses (Cont.)														
Havard panic Panicum havardii	x	x					x			x				
Indiangrass Sorghastrum nutans	x	x			x	1/	1/	1/	1/		1/			P,MC
Little bluestem Andropogon scoparius	x	x				x	x	x	x	x	x			P
Plains bristlegrass Setaria macrostachya	x						x	x				x		
Sand bluestem Andropogon hallii	x					x	x	x	x	x	x			PJ,P
Sand dropseed Sporobolus cryptandrus	x	x				x	x	x	x	x	x	x	x	SR,PJ
Sand lovegrass Eragrostis trichodes	x					x	x	x	x	x	x			
Sideoats grama Bouteloua curtipendula	x	x				x	x	x	x	x	x	x	x	SR,PJ, P
Spike muhly Muhlenbergia wrightii	x	x				x		x	x		x			PJ,P

Figure 5
(Cont.)
SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Cold - Dry Winters

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No.HP-3	So.WP-2	No.WP-3	RM-2
Warm Season Grasses (Cont.)														
Switchgrass Panicum virgatum	x	x		x	x	x		x	x		x			P,MC
Tobosa Hilaria mutica		x	x	x	x		x				x	x	x	
Vine-mesquite Panicum obtusum	x	x	x		x	x	x	x	x	x	x	x	x	
Weeping lovegrass Eragrostis curvula	x	x						x	x		x	x	x	SR,PJ
Yellow bluestem Bothriochloa ischaemum	x	x				x	x	x	x	x	x	x	x	SR,PJ
Forbs														
Alfalfa Medicago sativa	x	x												MC,P
Big trefoil Lotus uliginosus	x	x												MC,P
Birdsfoot trefoil Lotus corniculatus	x	x			x									MC,P

Figure 5
(Cont.)
SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Cold - Dry Winters

Species	Soil Groups					Sub-Resource Areas								South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No.HP-3	So.WP-2	No.WP-3	RM-2
Forbs (Cont.)														
Black medic Medicago lupulina	x	x			x									MC,P
Burnet Sanguisorba minor	x	x												MC,P
Cicer milkvetch Astragalus cicer	x	x			x									MC,P
Rocky Mountain penstemon Penstemon strictus	x	x												MC,P, PJ
Sainfoin Onobrychis viciaefolia		x												MC,P
Strawberry clover Trifolium fragiferum	x	x			x									MC,P
Sweetclover Melilotus sp.	x	x			x									MC,P
White clover Trifolium repens	x	x			x									MC,P

Figure 5
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Cold - Dry Winters

Species	Soil Groups													South
	Sandy	Loam	Clay	Salty	Wet	CP-1	CP-2	CP-3	HP-1	HP-2	No. HP-3	So. WP-2	No. WP-3	RM-2
Shrubs														
Antelope bitterbrush Purshia tridentata	x	x												PJ, P
Apache plume Fallugia paradoxa	x	x			x	x		x	x		x	x	x	SR, P, PJ
Fourwing saltbush Atriplex canescens	x	x	x	x	x	x	x	x	x	x	x	x	x	SR, PJ
Mountain mahogany Cercocarpus montanus	x	x												P, PJ
Rubber rabbitbrush Chrysothamnus nauseosus	x	x	x	x	x									SR, PJ
Winterfat Eurotia lanata	x	x				x		x	x		x	x	x	SR, PJ

Legend for Vegetative Zones within RM-2:
SR = Snakeweed-Rabbitbrush
P = Ponderosa pine
PJ = Pinyon juniper
MC = Mixed conifer
1/ = Wet sites only

Figure 6

.SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Warm - Dry Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	South HP-3	CP-4	South WP-3	SD-1	SD-2	SD-3
Cool Season Grasses											
Indian ricegrass Oryzopsis hymenoides	x	x				x	x	x	x	x	x
Warm Season Grasses											
Alkali sacaton Sporobolus airoides	x	x	x	x	x	x	x	x	x	x	x
Bermuda grass Cynodon dactylon		x	x	x	x	1/	1/	1/	1/	1/	1/
Black grama Bouteloua eriopoda	x	x				x	x	x	x	x	x
Blue grama Bouteloua gracilis	x	x		x		x	x	x	x		x
Blue panicgrass Panicum antidotale	x	x			x	1/	1/	1/	1/	1/	1/
Boer lovegrass Eragrostis chloromelas	x	x							x	x	x
Bush muhly Muhlenbergia porteri	x	x							x	x	x

1/ Wet sites only

Figure 6
(Cont.)

SPECIES ADAPTATION BY SOILS AND CLIMATE

CLIMATIC ZONE

Warm - Dry Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	South HP-3	CP-4	South WP-3	SD-1	SD-2	SD-3
Warm Season Grasses (Cont.)											
Havard panic Panicum havardii	x					x					x
Lehmann lovegrass Eragrostis lehmanniana	x	x							x	x	x
Little bluestem Andropogon scoparius	x					x	x	x			x
Plains bristlegrass Setaria macrostachya	x	x				x			x		x
Sand bluestem Andropogon hallii	x					x	x				x
Sand dropseed Sporobolus cryptandrus	x	x				x	x	x	x	x	x
Sand lovegrass Eragrostis trichodes	x					x					x
Sideoats grama Bouteloua curtipendula	x	x				x	x	x	x	x	x
Tobosa Hilaria mutica		x	x	x	x	x	x	x	x	x	x

1/ Wet sites only

Figure 6
(Cont.)
SPECIES ADAPTATION BY SOILS AND CLIMATE
CLIMATIC ZONE
Warm - Dry Winters

Species	Soil Groups					Sub-Resource Areas					
	Sandy	Loam	Clay	Salty	Wet	South HP-3	CP-4	South WP-3	SD-1	SD-2	SD-3
Warm Season Grasses (Cont.)											
Weeping lovegrass Eragrostis curvula	x	x				x					x
Wilman lovegrass Eragrostis superba	x	x							x	x	
Yellow bluestem Bothriochloa ischaemum		x				x		x	x		
Shrubs											
Fourwing saltbush Atriplex canescens	x	x	x	x		x	x	x	x	x	x